

Practical Applications in

SPORTS FIFTH EDITION **NUTRITION**

**Heather Hedrick Fink
Alan E. Mikesky**



Practical Applications in

SPORTS NUTRITION

FIFTH EDITION

Heather Hedrick Fink, MS, RD, CSSD

Owner
Nutrition and Wellness Solutions, LLC
Indianapolis, Indiana

Alan E. Mikesky, PhD, FACSM

Professor Emeritus
School of Physical Education and Tourism Management
Indiana University-Purdue University Indianapolis
Indianapolis, Indiana



JONES & BARTLETT
LEARNING

World Headquarters
Jones & Bartlett Learning
5 Wall Street
Burlington, MA 01803
978-443-5000
info@jblearning.com
www.jblearning.com

Jones & Bartlett Learning books and products are available through most bookstores and online booksellers. To contact Jones & Bartlett Learning directly, call 800-832-0034, fax 978-443-8000, or visit our website, www.jblearning.com.

Substantial discounts on bulk quantities of Jones & Bartlett Learning publications are available to corporations, professional associations, and other qualified organizations. For details and specific discount information, contact the special sales department at Jones & Bartlett Learning via the above contact information or send an email to specialsales@jblearning.com.

Copyright © 2018 by Jones & Bartlett Learning, LLC, an Ascend Learning Company

All rights reserved. No part of the material protected by this copyright may be reproduced or utilized in any form, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without written permission from the copyright owner.

The content, statements, views, and opinions herein are the sole expression of the respective authors and not that of Jones & Bartlett Learning, LLC. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not constitute or imply its endorsement or recommendation by Jones & Bartlett Learning, LLC and such reference shall not be used for advertising or product endorsement purposes. All trademarks displayed are the trademarks of the parties noted herein. *Practical Applications in Sports Nutrition, Fifth Edition* is an independent publication and has not been authorized, sponsored, or otherwise approved by the owners of the trademarks or service marks referenced in this product.

There may be images in this book that feature models; these models do not necessarily endorse, represent, or participate in the activities represented in the images. Any screenshots in this product are for educational and instructive purposes only. Any individuals and scenarios featured in the case studies throughout this product may be real or fictitious, but are used for instructional purposes only.

The authors, editor, and publisher have made every effort to provide accurate information. However, they are not responsible for errors, omissions, or for any outcomes related to the use of the contents of this book and take no responsibility for the use of the products and procedures described. Treatments and side effects described in this book may not be applicable to all people; likewise, some people may require a dose or experience a side effect that is not described herein. Drugs and medical devices are discussed that may have limited availability controlled by the Food and Drug Administration (FDA) for use only in a research study or clinical trial. Research, clinical practice, and government regulations often change the accepted standard in this field. When consideration is being given to use of any drug in the clinical setting, the health care provider or reader is responsible for determining FDA status of the drug, reading the package insert, and reviewing prescribing information for the most up-to-date recommendations on dose, precautions, and contraindications, and determining the appropriate usage for the product. This is especially important in the case of drugs that are new or seldom used.

10346-5

Production Credits

VP, Executive Publisher: David D. Cella
Publisher: Cathy L. Esperti
Acquisitions Editor: Sean Fabery
Associate Editor: Taylor Maurice
Reprints and Special Projects Manager: Tina Chen
Production Assistant: Molly Hogue
Production Assistant: Brooke Haley
Director of Marketing: Andrea DeFronzo

VP, Manufacturing and Inventory Control: Therese Connell
Composition: Cenveo Publisher Services
Cover Design: Kristin E. Parker
Rights & Media Specialist: Merideth Tumasz
Media Development Editor: Shannon Sheehan
Cover Image: © Chris Ryan/Getty Images
Printing and Binding: LSC Communications
Cover Printing: LSC Communications

Library of Congress Cataloging-in-Publication Data

Names: Fink, Heather Hedrick, author. | Mikesky, Alan E., author.
Title: Practical applications in sports nutrition / Heather Hedrick Fink, Alan E. Mikesky.
Description: Fifth edition. | Burlington, Massachusetts : Jones & Bartlett Learning, [2018] | Includes bibliographical references and index.
Identifiers: LCCN 2016048145 | ISBN 9781284101393 (pbk.)
Subjects: | MESH: Sports Nutritional Physiological Phenomena | Sports-physiology | Exercise-physiology | Sports Nutritional Sciences
Classification: LCC TX361.A8 | NLM QT 263 | DDC 613.2024796-dc23
LC record available at <https://lccn.loc.gov/2016048145>

6048

Printed in the United States of America
21 20 19 18 17 10 9 8 7 6 5 4 3 2 1

BRIEF CONTENTS

SECTION 1	The Basics of Sports Nutrition	1
CHAPTER 1	Introduction to Sports Nutrition	3
CHAPTER 2	Nutrients: Ingestion to Energy Metabolism	23
CHAPTER 3	Carbohydrates	59
CHAPTER 4	Fats	91
CHAPTER 5	Proteins	116
CHAPTER 6	Vitamins	141
CHAPTER 7	Minerals	178
CHAPTER 8	Water	210
CHAPTER 9	Nutritional Ergogenics	239
SECTION 2	The Practical Application of Sports Nutrition	261
CHAPTER 10	Nutrition Consultation with Athletes	263
CHAPTER 11	Weight Management	291
CHAPTER 12	Endurance and Ultra-Endurance Athletes	330
CHAPTER 13	Strength/Power Athletes	364
CHAPTER 14	Team Sport Athletes	392
CHAPTER 15	Special Populations	420
CHAPTER 16	Jobs in Sports Nutrition	455
APPENDIX A	You Are the Nutrition Coach – Answers	465
APPENDIX B	The Gastrointestinal Tract	471
APPENDIX C	Major Metabolic Pathways	474
APPENDIX D	Calculations and Conversations	480
APPENDIX E	Growth and Body Mass Index Charts	483
APPENDIX F	Dietary Reference Intakes	488

CONTENTS

Preface	xvi
How to Use This Book	xviii
About the Authorsxxiii
Acknowledgments	xxiv

SECTION 1 The Basics of Sports Nutrition 1

CHAPTER 1 Introduction to Sports Nutrition 3

What is sports nutrition?	4
Why study sports nutrition?	4
What are the basic nutrients?	4
What are carbohydrates?	5
What are proteins?	5
What are fats?	5
What are vitamins?	5
What are minerals?	5
What is water?	6
How does the body produce energy?	6
What are the dietary reference intakes?	6
What are enriched and fortified foods?	7
What are the basic nutrition guidelines?	7
What are the Dietary Guidelines for Americans?	7
What is the MyPlate food guidance system?	9
How should athletes interpret the information on food labels?	11
Who created the food label regulations?	11
How can the ingredient list be useful to athletes?	11
How can the nutrition facts panel be useful to athletes?	12
How can the percent daily value be useful to athletes?	14
How can nutrient content claims be useful to athletes?	15
How can health claims be useful to athletes?	16
What are the factors to consider when developing an individualized sports nutrition plan for athletes?	17
Why should a sports nutrition plan consider an athlete's health history?	18
Why should a sports nutrition plan consider a sport's bioenergetics and logistics?	19
Why should a sports nutrition plan consider an athlete's total weekly training and competition time?	19
Why should a sports nutrition plan consider an athlete's living arrangements, access to food, and travel schedule?	19
How can sports nutrition knowledge be converted into practical applications?	20
Key Points of Chapter	21
Study Questions	21
References	22

CHAPTER 2 Nutrients: Ingestion to Energy Metabolism 23

What happens to nutrients after they are ingested?	24
What are the functions of the various parts of the digestive system?	24

How are carbohydrates digested, absorbed, transported, and assimilated in the body?	27
What happens to carbohydrates once they are put into the mouth?	27
How are the simple sugars absorbed into the intestinal wall?	29
What happens to carbohydrates once they make it into the blood?	31
What happens to carbohydrates once they make it to the cells of the body?	31
How are fats digested, absorbed, transported, and assimilated in the body?	31
What happens to fats once they are put into the mouth?	34
What happens to the fats once they are absorbed?	34
What happens to fats once they make it to the cells?	35
How are proteins digested, absorbed, transported, and assimilated in the body?	35
What happens to proteins once they are put into the mouth?	35
How are proteins absorbed into the intestinal wall?	37
What happens to amino acids once they make it to the bloodstream?	38
What happens to amino acids once they make it to the cells of the body?	39
How are minerals, vitamins, and water absorbed and transported in the body?	40
What is energy metabolism, and why is it important?	41
What is energy?	41
What is the human body's source of chemical energy?	42
How do cells make ATP?	44
What are the three energy systems?	44
What are the characteristics of the phosphagen system?	46
What are the characteristics of the anaerobic and aerobic energy systems?	47
How do the energy systems work together to supply ATP during sport performance?	47
What metabolic pathways are involved with the energy systems?	49
Key Points of Chapter	56
Study Questions	57
References	58

CHAPTER 3 **Carbohydrates59**

What's the big deal about carbohydrates?	60
What are carbohydrates?	60
How are carbohydrates classified?	61
What are simple sugars?	61
What are complex carbohydrates?	63
Are artificial sweeteners carbohydrates? Are they beneficial or harmful?	65
What functions do carbohydrates serve in the body?	66
How can carbohydrates affect overall health?	67
What role does fiber play in health?	67
What role do simple sugars have in health?	68
How much carbohydrate should be consumed daily?	68
What is the relationship between current body weight and carbohydrate intake?	69
How can carbohydrate needs be determined based on a percentage of total calories?	69
What impact does the stage of training or competition schedule have on carbohydrate intake?	70
What are the various sources of dietary carbohydrates?	70
What are the best carbohydrate choices within the grains group?	71
What are the best carbohydrate choices within the fruit and vegetable groups?	71
What are the best carbohydrate choices within the dairy/alternative group?	71
What are the best carbohydrate choices within the protein foods group?	72

Can foods containing simple sugars or artificial sweeteners be used as a source of carbohydrates?	72
What are the glycemic index and glycemic load, and how can they be used in sports nutrition?	72
What is glycemic load?	73
How does the glycemic index relate to exercise?	74
How are carbohydrates utilized during exercise?	74
How much carbohydrate is stored within the body?	75
Why are carbohydrates an efficient fuel source?	76
Does carbohydrate intake enhance performance?	76
Does carbohydrate intake delay fatigue?	76
What type, how much, and when should carbohydrates be consumed before exercise?	77
What should an athlete eat on the days leading up to an important training session or competition?	78
What should an athlete eat in the hours leading up to an important training session or competition?	78
What type, how much, and when should carbohydrates be consumed during exercise?	81
What types of carbohydrates should be consumed during exercise or sport?	81
How much carbohydrate should be consumed during exercise or sport?	81
When should carbohydrates be consumed during exercise or sport?	83
What type, how much, and when should carbohydrates be consumed after exercise?	83
When should carbohydrates be consumed after exercise or sport?	83
What type of carbohydrates should be consumed after exercise or sport?	84
How much carbohydrate should be consumed after exercise or sport?	85
What are some examples of good meals/snacks for after exercising?	85
Key Points of Chapter	86
Study Questions	87
References	87
Additional Resources	90

CHAPTER 4 **Fats**91

What's the big deal about fats?	92
What are fats?	92
How are lipids (fats) classified?	92
What are triglycerides?	92
What is the molecular structure of a triglyceride?	92
What are some of the functions of triglycerides in the body?	93
What are fatty acids?	94
What are phospholipids?	98
What are sterols?	99
Is there such a thing as artificial fats?	100
How much fat is recommended in an athlete's diet?	101
Can a diet be too low in fat?	102
Can a diet be too high in fat?	102
Which foods contain fat?	103
How much fat is in the grains group?	103
How much fat is in the fruit and vegetable groups?	103
How much fat is in the dairy/alternative group?	103
How much fat is in the protein foods group?	104
How much fat is in the oils?	104

How can the percentage of calories from fat be calculated for specific foods?	104
What's the big deal about cholesterol?	106
What is dietary cholesterol, and which foods contain it?	106
How is blood cholesterol classified?	106
How can fats affect daily training and competitive performance?	108
What type, how much, and when should fats be consumed before exercise?	110
Is a single high-fat meal prior to exercise beneficial?	110
Is a short-term pattern of eating high-fat meals beneficial to exercise performance?	110
Is a long-term pattern of eating high-fat meals beneficial to exercise performance?	110
What are the recommendations for fat intake prior to exercise?	111
What type, how much, and when should fats be consumed during exercise?	111
What type, how much, and when should fats be consumed after exercise?	112
Key Points of Chapter	113
Study Questions	113
References	114
Additional Resources	115

CHAPTER 5**Proteins 116**

Why is protein important to athletes?	117
What are proteins?	117
What is the difference between a “complete” and an “incomplete” protein?	119
What are the main functions of proteins in the body?	121
What is nitrogen balance?	123
How much protein should athletes consume daily?	123
How can protein requirements be calculated based on body weight?	123
How do various dietary and training factors affect protein recommendations?	124
Can too much protein be harmful?	126
Which foods contain protein?	127
Which foods in the grains group contain protein?	127
Which foods in the fruit and vegetable groups contain protein?	127
Which foods in the dairy/alternative group contain protein?	128
Which foods make up the protein foods group?	128
Do foods in the oils and empty calories group contain protein?	128
Are protein supplements beneficial?	129
What is the quantity of protein or amino acids in the product? Is the supplement necessary?	129
What is the cost of protein supplements?	131
Will protein supplements enhance performance?	131
Are there any risks associated with taking the supplement?	132
Why is protein essential for daily training?	132
What type, how much, and when should protein be consumed before exercise?	133
What type and how much protein should be consumed 4 to 24 hours prior to training or competition?	134
What type and how much protein should be consumed 1 to 4 hours prior to training or competition?	134
What type, how much, and when should protein be consumed during exercise?	134
What type, how much, and when should protein be consumed after exercise?	135
Which type of protein or amino acid source is most beneficial to consume after exercise?	135
Is there a recovery benefit of combining carbohydrates and proteins after exercise?	136

How much protein should be consumed after exercise?	136
When should protein or amino acids be consumed after exercise?	137
Key Points of Chapter	138
Study Questions	138
References	139
Additional Resources	140

CHAPTER 6 **Vitamins** 141

What's the big deal about vitamins?	142
What are vitamins?	142
How are the dietary needs for vitamins represented?	142
What are the water-soluble vitamins?	142
Why is thiamin important to athletes?	144
Why is riboflavin important for athletes?	144
Why is niacin important for athletes?	145
Why is vitamin B ₆ important for athletes?	147
Why is vitamin B ₁₂ important for athletes?	149
Why is folate important for athletes?	151
Why is biotin important for athletes?	152
Why is pantothenic acid important for athletes?	154
Why is choline important for athletes?	154
Why is vitamin C important for athletes?	156
What are the fat-soluble vitamins?	157
Why is vitamin A important for athletes?	158
Why are the carotenoids important for athletes?	160
Why is vitamin D important for athletes?	161
Why is vitamin E important for athletes?	164
Why is vitamin K important for athletes?	166
Which vitamins or compounds have antioxidant properties?	166
What are free radicals?	166
What is the relationship between free radicals and exercise?	168
Do athletes need antioxidant supplements?	168
What are phytochemicals?	170
What are phenolic compounds?	170
What are organosulfides?	171
What is lycopene?	171
How can athletes increase phytochemical consumption through whole foods?	172
Key Points of Chapter	174
Study Questions	175
References	175
Additional Resource	177

CHAPTER 7 **Minerals** 178

What's the big deal about minerals?	179
What are minerals?	179
What are the major minerals?	179
Why is calcium important for athletes?	181
Why is phosphorus important to athletes?	183
Why is magnesium important for athletes?	184
Why is sodium important for athletes?	187
Why is chloride important for athletes?	188
Why is potassium important for athletes?	188
Why is sulfur important for athletes?	190

What are the trace minerals? 191

- Why is iron important for athletes? 191
- Why is zinc important for athletes? 195
- Why is chromium important for athletes? 196
- Why is fluoride important for athletes? 197
- Why is copper important for athletes? 199
- Why is manganese important for athletes? 200
- Why is iodine important for athletes? 201
- Why is molybdenum important for athletes? 201
- Why is selenium important for athletes? 202
- Are other trace minerals important for athletes? 203

Key Points of Chapter 206

Study Questions 206

References 207

Additional Resources 209

CHAPTER 8 Water 210**What's the big deal about water? 211**

- What are the functions of water in the body? 211
- What are the sources of water? 212
- What are the ways in which we lose body water? 213

What are the consequences of poor water balance? 214

- Is it possible to overhydrate the body? 216
- How can hydration status be monitored? 216

How much fluid do individuals need on a daily basis? 218

- What are the current recommendations for daily fluid intake? 218
- Can certain beverages, foods, or medications contribute to fluid losses? 219
- What are some practical guidelines for consuming fluids on a daily basis? 220

What is the role of preexercise hydration? 220

- How much fluid should be consumed before exercise? 220
- What types of fluids should be consumed? 220
- What are practical guidelines for consuming fluids before exercise? 222

What is the role of hydration during exercise? 222

- What is the magnitude of water and electrolyte losses during exercise? 222
- How much fluid should be consumed during exercise? 223
- What types of fluids should be consumed during exercise? 225
- What are some practical guidelines for consuming fluids during exercise? 230

What is the role of postexercise hydration? 233

- How much fluid should be consumed? 233
- What types of fluids should be consumed? 233
- Are supplements beneficial after exercise? 234
- What are some practical guidelines for consuming fluids after exercise? 235

Key Points of Chapter 236

Study Questions 236

References 237

CHAPTER 9 Nutritional Ergogenics 239**What is an ergogenic aid? 240****What are dietary supplements? 241**

- Why do athletes use dietary supplements? 241
- What are the regulations governing dietary supplements? 242
- Are some supplements better or safer than others? 244

Where can information on nutritional ergogenic aids be found?	246
What tools are available to research information on ergogenic aids?	246
What is doping?	248
What are some of the commonly encountered doping substances?	251
Which nutritional ergogenic aids are commonly used as anabolic agents, prohormones, and hormone releasers?	251
Which nutritional ergogenic aids are commonly used to reduce fat mass?	253
Which nutritional ergogenic aids are commonly used as anticatabolics?	253
Which vitamins and minerals are commonly used as nutritional ergogenic aids?	254
What types of dietary supplements and nutritional ergogenics are commonly used by endurance athletes, strength/power athletes, and team sport athletes?	254
Key Points of Chapter	259
Study Questions	259
References	260

SECTION 2 The Practical Application of Sports Nutrition 261

CHAPTER 10 Nutrition Consultation with Athletes 263

Why is nutrition consultation and communication with athletes important?	264
How much do athletes know about sports nutrition?	264
Who provides nutrition assessment and education to athletes?	265
How does the consultation process with athletes begin?	266
What is a diet history?	266
What is a health history questionnaire?	266
Why is an inquiry about supplement use important?	268
What type of food intake information should be obtained from the athlete?	268
How is an exercise/training log used in a nutrition consultation?	271
Which clinical assessments should be conducted in the initial consultation session?	272
How are food records analyzed?	273
How do you compare dietary intake to nutrition recommendations?	274
What are the steps for the initial consultation with the athlete?	277
How is rapport established with an athlete?	278
How can you determine the reasons for a requested consultation?	278
How is the nutrition assessment conducted?	278
How can an athlete's readiness for change be assessed?	281
How can appropriate nutrition goals be established?	283
How can appropriate nutrition education be provided to an athlete?	284
How should a consultation be summarized and closed?	285
What are the steps for a follow-up consultation with the athlete?	285
What should walk-in or short sessions with athletes involve?	286
Are there any concerns about the confidentiality of the health, nutrition, and exercise information provided by the athlete?	287

Key Points of Chapter	289
Study Questions	289
References	290

CHAPTER 11 Weight Management 291

What are the common weight management concerns for athletes?	292
What are the prevalence and significance of overweight and obesity?	292
What are the main health consequences and health risks of overweight and obesity?	293

What methods are used to determine weight status?	294
What is body mass index?	294
What can measures of body fat distribution tell us?	295
Why is body composition important?	296
What makes up the composition of the body?	296
What are the methods for measuring body composition?	297
How does body composition affect sport performance?	301
What are the components of energy intake and energy expenditure?	302
What influences energy intake?	302
What are the components of energy expenditure?	303
What methods do athletes use to lose weight?	306
How are weight and body composition goals for athletes determined?	306
How are energy needs for weight loss determined?	307
What dietary changes are necessary for athletes to lose weight?	307
How do exercise and physical activity influence weight loss for athletes?	309
How does goal setting help athletes lose weight?	310
What are the summary recommendations for athletes regarding weight loss?	311
What are the weight loss issues for athletes in weight classification sports?	312
What happens when weight loss efforts develop into disordered eating patterns?	315
What are the different types of eating disorders?	315
What are the main concerns regarding female athletes and eating disturbances/disorders?	317
What are the main concerns regarding male athletes and eating disturbances/disorders?	319
What are the best treatment options for eating disorders?	320
How can eating disorders be prevented?	320
How can athletes gain weight healthfully?	322
What kind of resistance training program is best for gaining weight?	322
How can an athlete achieve a positive energy balance?	323
How can an athlete achieve a positive nitrogen balance?	324
Do athletes need dietary supplements to gain weight?	324
What other dietary practices might help an athlete gain weight?	325
Key Points of Chapter	326
Study Questions	327
References	327
Additional Resources	329

CHAPTER 12 **Endurance and Ultra-Endurance Athletes 330**

What is different about endurance athletes?	331
What energy systems are utilized during endurance exercise?	331
Are total energy needs for endurance athletes different from energy needs of other types of athletes?	331
How are daily energy needs calculated for endurance athletes?	332
How many calories should be consumed during endurance training or competition?	333
How many calories are required after a training session or competitive event?	334
Are macronutrient needs different for endurance athletes?	334
How important are carbohydrates to endurance athletes?	335
How are daily carbohydrate needs calculated for endurance athletes?	335
How should endurance athletes carbohydrate-load before competition?	336
Should carbohydrates be consumed in the hours or minutes prior to endurance activities?	337

Should the endurance athlete consume carbohydrates during endurance activities?	338
Is carbohydrate intake important during the recovery period after endurance training or competition?	338
Are protein needs different for endurance athletes?	340
How are daily protein needs calculated for endurance athletes?	340
What is the effect of consuming protein prior to endurance activities?	341
Should proteins be ingested during endurance activities?	342
Is protein needed for recovery from endurance exercise?	343
Should endurance athletes eat more fats to meet their energy needs?	344
How are daily fat needs calculated for endurance athletes?	346
Should fats be eaten while performing endurance activities?	347
Is fat needed for recovery from endurance exercise?	348
Are vitamin/mineral needs different for endurance athletes?	348
Why are the B vitamins important for endurance athletes?	348
Why are vitamins C and E important for endurance athletes?	348
Why is iron important for endurance athletes?	349
Why is calcium important for endurance athletes?	350
Why are sodium and potassium important for endurance athletes?	350
Why are fluids critical to endurance performance?	350
How are daily fluid needs calculated for endurance athletes?	351
How are fluid and electrolyte needs during endurance activities determined?	351
What meal planning/event logistics need to be considered during endurance events?	354
How can a nutrition plan be developed for sports that are not conducive to consuming foods or fluids while exercising?	354
How can a nutrition plan be developed for sports lasting 24 hours or longer?	357
How can a nutrition plan be developed for a multiday event that will be fully supported?	357
How can a meal plan be developed for a sport such as a long-distance triathlon that includes a nonconductive eating environment, a length of time spanning several meals, and race course support?	358
Key Points of Chapter	360
Study Questions	361
References	361
Additional Resources	363

CHAPTER 13**Strength/Power Athletes..... 364**

What is different about strength/power athletes?	365
What energy systems are utilized during strength/power exercise?	365
Are the calorie needs of strength/power athletes different from those of other types of athletes?	366
How are daily calorie needs calculated for strength/power athletes?	366
How are calorie needs calculated during strength/power training and competition?	371
Are carbohydrate needs different for strength/power athletes?	372
How are daily carbohydrate needs calculated for strength/power athletes?	372
Are carbohydrates needed before and during training and competition?	373
Are carbohydrates needed for recovery from strength/power activities?	375
Are protein needs different for strength/power athletes?	375
How are daily protein needs calculated for strength/power athletes?	376
Do individual amino acids have an ergogenic effect on muscle growth and development?	377

Is protein needed before and during training sessions and competitions? 377

Is protein needed for recovery from strength/power activities? 378

Are fat needs different for strength/power athletes? 379

How are daily fat needs calculated for strength/power athletes? 379

Are fats needed before and during training sessions and competitions? 380

Is fat needed for recovery from strength/power activities? 380

Are vitamin and mineral needs different for strength/power athletes? 380

Do strength/power athletes need to supplement with antioxidant vitamins? 380

Should strength/power athletes supplement boron intake? 380

Should strength/power athletes be concerned about calcium intake? 381

Is chromium supplementation important for strength/power athletes? 381

Should strength/power athletes worry about iron? 381

Is magnesium supplementation important for strength/power athletes? 382

Why is zinc important for strength/power athletes? 382

Is multivitamin/mineral supplementation necessary for strength/power athletes? 382

Are fluid needs different for strength/power athletes? 382

What issues are of concern regarding the fluid intake of strength/power athletes? 382

How are fluid needs during strength/power activities determined? 384

What should athletes drink and when should they drink it? 384

How much fluid should strength/power athletes drink after training sessions and competitive events? 385

What meal-planning/event logistics need to be considered during strength/power events? 385

What are high-quality options for snacks between events at meets? 385

What are high-quality options for snacks after competition? 385

Key Points of Chapter 387

Study Questions 388

References 388

Additional Resources 391

CHAPTER 14 Team Sport Athletes..... 392

What is different about athletes in team sports? 393

What energy systems are utilized during team sports? 393

How are energy needs different for team sport athletes? 394

How are daily energy needs calculated for team sport athletes? 394

How can energy needs during an event be calculated? 395

Are carbohydrate needs different for team sport athletes? 395

How are daily carbohydrate needs calculated for team sport athletes? 397

What is the effect of carbohydrate consumption prior to team sport activities? 398

Is carbohydrate intake required during team sport activities? 399

Is carbohydrate intake needed for recovery from team sport activities? 400

Are protein needs different for team sport athletes? 400

How are daily protein needs calculated for team sport athletes? 400

Is protein recommended after exercise for recovery? 402

Are fat needs different for team sport athletes? 402

How are daily fat needs calculated for team sport athletes? 402

Is fat recommended after exercise for recovery? 404

Are vitamin and mineral needs different for team sport athletes? 404

How does vitamin intake of team sport athletes compare to the dietary intake standards? 404

How does mineral intake of team sport athletes compare to the dietary intake standards? 404

How does energy consumption affect vitamin and mineral intake?	405
Are vitamin and mineral supplements recommended for team sport athletes?	406
What are the fluid recommendations for team sport athletes?	407
Why are fluids critical to team sport performance?	408
How can dehydration be prevented in team athletes?	408
What meal-planning/event logistics need to be considered during team sport events?	410
Should food be consumed during an event?	410
What should athletes consume between games and at tournaments?	410
Which foods are recommended for athletes while traveling?	412
Key Points of Chapter	416
Study Questions	417
References	417
Additional Resources	419

CHAPTER 15 **Special Populations** 420

What is a “special population”?	421
What are the special considerations for athletes with diabetes?	421
What are the main types of diabetes?	422
What are the considerations related to exercise for athletes with diabetes?	423
How can athletes manage their diabetes and excel in sports?	423
What are the special considerations for athletes who are pregnant?	427
How are an athlete’s caloric requirements affected by pregnancy?	427
How are an athlete’s protein requirements affected by pregnancy?	428
How are an athlete’s B vitamin requirements affected by pregnancy?	428
How are an athlete’s vitamin C requirements affected by pregnancy?	429
How are an athlete’s vitamin A requirements affected by pregnancy?	429
How are an athlete’s magnesium requirements affected by pregnancy?	430
How are an athlete’s iron requirements affected by pregnancy?	430
What are the special considerations for child and teen athletes?	431
How does nutrition affect growth and maturation in the child or teen athlete?	431
Are fluid needs for young athletes different from those of adult athletes?	434
Do young athletes require higher vitamin and mineral intake?	434
What are the special considerations for college athletes?	435
Are college athletes’ energy needs higher than their precollege needs?	435
What are practical tips for the implementation of a college athlete’s meal plan?	436
How does alcohol consumption affect college athletes’ nutrition?	437
What are the special considerations for masters athletes?	440
How do the nutrient needs of masters athletes change?	441
How does the presence of chronic disease affect nutrient needs of masters athletes?	443
What are the special considerations for vegetarian athletes?	443
What are the various types of vegetarianism?	444
Which vegetarian foods are rich in protein?	446
Which vegetarian foods are rich in iron?	448
Which vegetarian foods are rich in zinc?	449
Which vegetarian foods are rich in calcium and vitamin D?	449
Which vegetarian foods are rich in vitamin B ₁₂ ?	449
Key Points of Chapter	451
Study Questions	452
References	452
Additional Resources	454

CHAPTER 16	Jobs in Sports Nutrition	455
	Why should you consider becoming a registered dietitian?	456
	What are the steps to becoming a registered dietitian?	456
	What are the curriculum requirements for an undergraduate degree in dietetics?	456
	Do individuals need a graduate degree to be a sports dietitian?	457
	What do the dietetic internships entail, and how does the experience relate to becoming a dietitian?	457
	How is the board exam taken, and what topic areas are covered?	458
	Is continuing education required once the RD credential is obtained?	458
	What is the Board Certified as a Specialist in Sports Dietetics credential?	459
	Is licensure necessary for registered dietitians?	459
	What if you are not an RD and don't have a license—can you still give nutrition advice to athletes?	459
	How can students and professionals obtain practical experience in the field of sports nutrition?	460
	What are the potential job markets in sports nutrition?	461
	Key Points of Chapter	464
	Study Questions	464
	References	464
APPENDIX A	You Are the Nutrition Coach – Answers	465
APPENDIX B	The Gastrointestinal Tract	471
APPENDIX C	Major Metabolic Pathways	474
APPENDIX D	Calculations and Conversations	480
APPENDIX E	Growth and Body Mass Index Charts	483
APPENDIX F	Dietary Reference Intakes	488
GLOSSARY	492
INDEX	503

PREFACE

Sports nutrition is an exciting field that combines the sciences of nutrition and exercise physiology. The generally accepted notion that proper nutrition can positively impact athletic performance has created the need for exercise and nutrition professionals to acquire knowledge that goes beyond the basics of general nutrition.

In addition, emerging career opportunities in sports nutrition require that academic programs preparing registered dietitians expand the application of nutrition beyond the clinical population. Strength coaches and personal trainers also need to go beyond the nutrition basics to help their athletes achieve optimal performance. The growing research base supporting the importance of sports nutrition and the inherent interest of athletes seeking a nutritional edge have created an increased demand for sports nutrition courses in dietetic and exercise science programs.

In order to obtain a job in the sports nutrition field, readers need to understand current nutrition guidelines, be aware of the results of emerging research, and be able to practically apply sports nutrition knowledge to athletes of all ages, sports, and abilities. This text has been developed to meet these needs, providing readers with an opportunity to learn the most up-to-date information related to diet and athletic performance while also addressing consultation skills and giving readers the tools they need to educate others properly. The focus on research, current guidelines, and practical application of information makes this sports nutrition textbook unique among other texts currently on the market.

Undergraduate and graduate students as well as professionals from several different backgrounds will benefit from this textbook. Students in dietetics, exercise science, and athletic training programs will enhance their education with an understanding of the relationship among essential nutrients, energy metabolism, and optimal sports performance. Dietetics students seeking the registered dietitian (RD) credential will appreciate the thorough explanations and many helpful tips on how to guide an athlete through nutrition consultations. Exercise science and athletic training students will learn how to educate athletes regarding public domain sports nutrition guidelines as well as how to work together as a team with a registered dietitian and physician. Current professionals in the field of sports nutrition will benefit from adding this text to their reference library due to the straightforward and complete presentation of current sports nutrition recommendations and examples of practical applications for athletes participating in endurance, strength/power, and team sports.

Organization and Enhancements

The most exciting change included in this fifth edition of *Practical Applications in Sports Nutrition* is its new, full-color layout. There is no question that color adds a new dimension to the text's readability, and it serves to even better highlight the various features of the text.

As in previous editions, Chapters 1 through 9 provide an introduction to sports nutrition, including the definition of sports nutrition and an explanation of general nutrition concepts; a review of digestion and energy metabolism; a thorough explanation of macronutrients, micronutrients, and water and their relation to athletic performance; and, finally, an overview of nutritional ergogenics. Enhancements within Chapters 1–9 in this fifth edition include:

- Updated/revised figures and tables throughout
- The introduction and discussion of new labeling requirements and how to use them
- Updated sport nutrition recommendations based on the 2016 position statement from the American College of Sports Medicine (ACSM), the Academy of Nutrition and Dietetics (AND), and the Dietitians of Canada (DC)
- The inclusion of the new 2016 World Anti-Doping Association Prohibited Substances List
- Several new Fortifying Your Nutrition Knowledge features (e.g., Mobile Apps: Technology in Weight Management).

Several of this textbook's unique features appear in the second half of the text, within the practical application section. Chapter 10 focuses on how to educate, communicate with, and empower athletes to make behavior changes through nutrition consultations. Chapter 11 covers enhancing athletic performance through nutrition while also focusing on weight management, including weight loss, weight gain, and eating disorders. Changes to Chapter 11 include updated statistics and graphs on obesity, as well as condensed sections covering body composition measurement and weight loss.

In Chapters 12–14, sports are divided into three categories: endurance, strength/power, and team, each covered separately. Each chapter reviews the most current research as it relates to the energy systems and specific nutrition needs of athletes, which as noted earlier, reflect the new sports nutrition recommendations of ACSM, AND, and DC for these various categories of sports. Chapters 12–14 serve as examples of one of the main objectives of this book: To empower individuals to excel in the sports nutrition field by teaching sports nutrition

guidelines and showing how to apply the concepts to athletes in various sports. These chapters demonstrate how to give advice that is practical and easy to follow.

Due to the increasing occurrence of athletes with special medical or nutritional considerations—including those who are pregnant, vegetarian, masters athletes, or have chronic diseases—Chapter 15 targets the unique nutrition requirements of these special populations. The text concludes with a chapter dedicated to helping readers discover and understand the pathway to becoming a sports dietitian through education and experience. Enhancements to Chapters 15 and 16 include updated tables, references, resources, and websites.

The Pedagogy

Throughout the text the primary, secondary, and tertiary section headings are phrased as questions. We formatted the section headings as questions to help readers focus

their attention and to foster interest in the topic before they begin to read. In other words, they are “directed” to read about topics with the specific purpose of obtaining an answer to a question. This is an effective way of reading and borrows from the work of Francis Robinson, who developed the widely used “preview-question-read-recite-review” (PQ3R) reading technique. The goal is to prevent “hollow reading,” in which a person reads the words on the pages but without a specific understanding or perspective of why he or she is reading.

Our mission is for readers to become engrossed in their reading with the hope that they will be inspired to learn more about the relatively new and growing field of sports nutrition. After all, regardless of where a reader’s academic and career paths may lead, knowledge of good nutrition is universally applicable to one’s personal health and well-being, to enjoyment of recreational and sports activities, and, in the case of dietitians and fitness professionals, to career success.

HOW TO USE THIS BOOK

Key Questions Addressed sections open each chapter and introduce students to key material, piquing their interest in covered topics and encouraging purposeful reading.

You Are the Nutrition Coach case studies at the beginning of the chapter provide context to chapter material. Students are urged to carefully consider the case study prior to reading the chapter and reconsider it after completing their reading.



CHAPTER 6

Vitamins

● Key Questions Addressed

1. What's the big deal about vitamins?
2. What are vitamins?
3. How are the dietary needs for vitamins represented?
4. What are the water-soluble vitamins?
5. What are the fat-soluble vitamins?
6. Which vitamins or compounds have antioxidant properties?
7. What are phytochemicals?



● You Are the Nutrition Coach ●

Roger is a starting guard on his college basketball team. He is a leader on his team, stays after practice to work on his shots, and is busy with academic and community life on campus. Because of his hectic schedule, he has little time for meal planning, grocery shopping, and food preparation. Dinner is usually consumed at the athletics training table during the week, and the rest of his meals are consumed either at home or at local restaurants. A 3-day food record kept by Roger recently was analyzed using a nutrition software program. The analysis revealed overall energy intake was not meeting his estimated needs, and vitamins A, C, and folate were consistently low throughout the 3-day period. The rest of the vitamins and minerals met the minimum RDA or AI requirements.

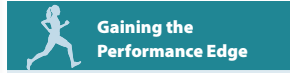
Questions

- What questions should you ask Roger about his typical daily diet?
- What recommendations do you have for Roger to improve his dietary intake of vitamins and his energy intake?
- How can you help Roger meet these recommendations?

Gaining the Performance Edge boxes provide insightful tips on how to apply sports nutrition knowledge when working with athletes.

Fortifying Your Nutrition Knowledge boxes expand on timely topics with the intent of providing information that is beyond the basics of the sports nutrition topic being discussed.

Key Terms are bolded within the text and defined in a sidebar to help students quickly identify and understand new terms.



Gaining the Performance Edge

Cutting carbohydrates from an athlete's diet leads to "performance suicide." Carbohydrates are the "master fuel" for all sports.

deficit in needed carbohydrates. Finally, carbohydrates are the primary energy source for the nervous system. Nerve cells do not store carbohydrates like muscle cells do; their source for carbohydrates is the bloodstream. When blood glucose levels fall, nerve cell function suffers, which can have a dramatic effect on exercise and sport performance.

Fortifying Your Nutrition Knowledge



What Does "Low Carb" Mean?

The FDA regulation for nutrient content claims allows manufacturers to highlight and make health-related claims on their food labels regarding certain nutrients or dietary substances in their products. However, the FDA permits only specified nutrients or substances to have these nutrient content claims. The FDA has not established a set of values for descriptors identifying carbohydrates. Food manufacturers can put quantitative statements on labels such as "6 grams of carbohydrates" as long as they are factual. However, they cannot make a statement such as "only 6 grams of carbohydrates" because that implies the food is a carbohydrate-reduced or low-carbohydrate food. If the label "characterizes" the level of a nutrient, then it is considered a nutrient content claim. Therefore, a claim of "low carbohydrate" cannot be used on food labels because it characterizes the amount of carbohydrates in that food.

Although there are no official definitions of low carbohydrate, the FDA is gathering evidence and will potentially develop a statement outlining carbohydrate food-labeling guidelines. Guidelines are likely to be similar to those established for such terms as "low fat," "reduced fat," or "reduced sugar." These will list the number of grams of carbohydrates to be considered "low" and probably will include definitions of reduced carbohydrates as well.

How can carbohydrates affect overall health?

It is widely recognized that a diet moderate to high in carbohydrates is important for optimal daily training, high energy levels, and overall good health. Carbohydrate-rich foods contain not only energy for working muscles, but also nutrients required for proper body functioning, such as fiber, vitamins and minerals, and various **phytochemicals**.

phytochemicals A large class of biologically active plant chemicals that have been found to play a role in the maintenance of human health.

What role does fiber play in health?

Fiber is a complex carbohydrate that the body cannot digest or absorb. Most fibers are made up of long chains of sugar units and thus are classified as polysaccharides. However, unlike starch, fiber polysaccharides cannot be broken down by human digestive enzymes into small enough units for the body to absorb. Thus, fiber, with the exception of some resistant starches, does not contribute energy to the body as do other digestible carbohydrates. Even though it is a minimal energy source, fiber promotes good health in many ways.⁸

When we eat plant foods, the indigestible fiber portion adds bulk to the intestinal contents. It does so by attracting water into the intestines, some of which is absorbed by the fiber itself, causing it to expand. The greater the bulk of the intestinal contents, the greater the peristaltic actions of the smooth muscles in the intestinal walls and the faster the passage of foods through the digestive system. The water drawn in by the fiber also helps soften the stools for easy passage out of the system. If fiber intake is low, there is less water and less intestinal bulk, which results in stools that are small and hard, and that pass more slowly through the length of the intestines. Constipation and hemorrhoids can occur more readily when stools are hard and when fiber intake is low. Constipation produces an uncomfortable full feeling, often with gas, and is particularly uncomfortable during exercise.

Active individuals who eat adequate fiber and consume adequate fluids will have fewer problems with constipation than those who do not exercise. Physical exercise not only strengthens the muscles used during exercise, but also tends to produce a healthier GI tract that moves food and fluids efficiently and quickly through the system. This is just another example of the importance of combining exercise with good nutrition.

Choosing foods rich in fiber may help reduce the risk of some types of cancers.⁸ The link between fiber and colon cancer has received much attention. Controversy exists in the research as to whether fiber has a positive or a neutral effect on the risk for colon cancer. Some studies support a positive correlation between high fiber intakes and colon cancer risk reduction,^{9,10} whereas others do not support this finding.¹¹⁻¹³ The theory behind fiber's potential ability to decrease colon cancer risk is that the higher bulk of insoluble fibers may "dilute" toxins in the intestinal tract plus speed the passage of toxins out of the body. This decreased transit time may reduce the amount of contact between potential cancer-causing agents and the intestinal mucosal cells. More research, especially studies that control for type of fiber and food intake, needs to be conducted to determine whether there is a direct correlation between high fiber intake and a lowered incidence of colon cancer. Regardless of future findings, eating a diet rich in complex carbohydrates, including fruits, vegetables, whole grains, and legumes, provides a healthful diet and can aid in the prevention of many other disease conditions (see **FIGURE 3.6**).

Training Tables help students translate sports nutrition knowledge into actual meal planning ideas, recipes, or food selections.

Training Table 7.3: Summertime Salad

This salad tastes best during the summer months when tomatoes are in season.

1 small tomato, diced

¼ whole cucumber, diced

¼ cup red onion, diced

2 tbsp light Italian dressing

Mix together the vegetables and dressing.

Chill before serving.

Serving size: 1½ cups (recipe makes one serving)

Calories: 95 kcals

Protein: 2 grams

Carbohydrate: 12 grams

Fat: 5 grams

What is a suggestion for a potassium-rich meal or snack?

Snack: Summertime Salad (see **TRAINING TABLE 7.3**)

Total potassium content = 457 milligrams

Do athletes need potassium supplements?

Potassium supplements are not needed and can cause harm in large doses. For athletes, the emphasis should be placed on food sources of potassium because adequate potassium intake is easily attainable through a balanced diet. Large doses of supplemental potassium, at levels of 18,000 milligrams or higher, can disrupt muscle contraction and nerve transmission, ultimately leading to a heart attack.

Why is sulfur important for athletes?

Sulfur is unique because it is considered an essential nutrient, but it does not have an established RDA, EAR, AI, or UL.²⁹ Regardless of the lack of hard numbers, sulfur or sulfate is a nutrient that athletes should consume on a daily basis for proper bodily functioning.

What is the RDA/AI for sulfur?

There is no RDA, EAR, or AI for sulfur because of the fact that it can be obtained from food and water, as well as be derived from specific amino acids in the body.²⁹

What are the functions of sulfur for health and performance?

Sulfur is a component of hundreds of compounds in the body. The body synthesizes the majority of these compounds using the sulfur consumed in the diet and from sulfur produced in the body from degradation of the amino acids methionine and cysteine. The most notable sulfur-containing compound in the body is 3-phosphoadenosine-5-phosphosulfate (PAPS). Sulfate derived from methionine and cysteine found in dietary proteins and the cysteine component of glutathione provide sulfate for use in PAPS synthesis.²⁹ PAPS, in turn, is then used in the biosynthesis of other essential body compounds.²⁹ Sulfur has also been associated with the growth and development of tissues.

In regard to athletic performance, there is no evidence that the ingestion of excess sulfur is ergogenic.

What are the complications of sulfur deficiency?

Deficiencies of sulfur are rare, unless a protein deficiency is also present, which would include a deficiency in methionine and cysteine. Under normal conditions, it appears that adequate sulfur spares cysteine from the synthesis of PAPS, allowing cysteine to instead be used for protein synthesis and growth. When sulfur is present in suboptimal levels, cysteine is required for the production of PAPS, thus sacrificing protein synthesis.

What are the symptoms of sulfur toxicity?

There have been reports of individuals suffering from osmotic diarrhea after consuming large quantities of sulfur.²⁹ An association has also been suggested between high sulfur intakes and the risk of ulcerative colitis. Unfortunately, at this time there is insufficient evidence to formulate recommendations for sulfur intake, including the establishment of an upper limit.²⁹

Which foods are rich in sulfur?

Sulfur is found in a variety of foods, with the highest concentrations found in some fruits, soy flour, certain breads, and sausages. Juices, beers, wines, and ciders also contain a significant quantity of sulfur. Drinking water is another common source of sulfur; however, quantities can vary dramatically based on the region of the country and the water source.

What is a suggestion for a sulfur-rich meal or snack?

Because no RDA/AI level has been set for sulfur, a “sulfur-rich” meal cannot be recommended. Athletes should include sulfur-containing foods on a daily basis in addition to consuming adequate levels of protein.

Do athletes need sulfur supplements?

Because an insufficient amount of information is available to even draw conclusions on an RDA, EAR, AI, or UL for sulfur, recommending sulfur supplements does not appear to be warranted at this time.



Gaining the Performance Edge

The major minerals include calcium, phosphorus, magnesium, sodium, chloride, potassium, and sulfur. Each of these minerals plays a specific and important role in overall health and athletic performance. Athletes should strive to consume these nutrients from whole foods first, and rely on supplements only when individually indicated.

Food for Thought 7.1

Importance of Mineral Intake for Athletes: Major Minerals

Review the recommendations, food sources, and significance of major minerals for athletes.

Food for Thought callouts refer students to web-based workbook activities to further their understanding or engagement in nutritional topics.

The **Box Score** concludes each chapter with **Key Points** and numerous **Study Questions**, which continue to engage students in thoughtful review of important chapter material.

The Box Score

Key Points of Chapter

- To become a registered dietitian (RD), individuals must meet specific requirements in undergraduate college courses and obtain a minimum of a bachelor's degree at an accredited college or university.
- Registered dietitians have to obtain a minimum of 1200 hours of supervised experience after obtaining a bachelor's degree before they can take the registration exam for dietitians.
- In some states, registered dietitians must be licensed, in addition to being registered. Laws in states that require licensure are developed to protect the public from harm that could potentially be done by individuals who say they are "nutritionists." These individuals typically have not had the same education, training, or supervision as registered and licensed dietitians.
- Non-nutrition-credentialed professionals should check licensure laws in their state to be sure they are not providing nutrition services outside of the law. Much public domain information is available for all professionals to educate athletes in order to help them with performance nutrition.
- The Board Certified as a Specialist in Sports Dietetics (CSSD) credential is a certification offered by the Commission on Dietetic Registration of the Academy of Nutrition and Dietetics. Individuals with this credential are recognized as knowledgeable and experienced in working with athletes and nutrition for performance enhancement.
- Obtaining the RD credential is the first step to becoming a sports dietitian. Additional work and volunteer experience in the sports nutrition arena, as well as possible graduate studies in the exercise science field, will prepare dietitians for a job in sports nutrition.

Study Questions

1. What, if any, are the differences between a sports nutritionist and a dietitian?
2. In what job settings can registered dietitians be found?
3. What are the three required steps that must be completed in order to become a registered dietitian?
4. What academic coursework should students be prepared to take when pursuing a BS degree in dietetics?
5. Discuss the various ways in which a registered dietitian may obtain continuing education credits.
6. Discuss some of the various ways that students interested in sports nutrition can get field experience.
7. What are some of the daily roles and responsibilities of a registered dietitian involved in sports nutrition?
8. What nutrition information can an individual who is not a licensed or registered dietitian provide to athletes? What are the legal and ethical issues surrounding noncredentialed nutrition assessment and therapy?
9. Explain the qualification requirements for the CSSD credential. Why is this credential important in the sports nutrition field?

References

1. Academy of Nutrition and Dietetics, Accreditation Counsel for Education in Nutrition and Dietetics. Accreditation Standards for Didactic Programs in Nutrition and Dietetics. Available at: <http://www.eatrightacend.org/ACEND/>. Accessed April 25, 2016.
2. Academy of Nutrition and Dietetics, Commission on Dietetic Registration. Sports Dietetics Application Information. Available at: www.cdrnet.org/certifications/board-certification-as-a-specialist-in-sports-dietetics. Accessed April 25, 2016.
3. Commission on Dietetic Registration. State Licensure. Available at: <http://cdrnet.org/state-licensure>. Accessed April 25, 2016.
4. Driskell JA, Wolinsky I. *Nutritional Assessment of Athletes*. Boca Raton, FL: CRC Press; 2002.
5. Rogers D. Dietetics trends as reflected in various primary research projects, 1995–2011. *J Acad Nutr Diet*. 2012;112(suppl 1):64S–74S.

Integrated Teaching and Learning Package

A robust set of instructor's resources are available to qualified instructors. They include the following:

- LMS-ready Test Bank, featuring more than 1,000 questions
- Slides in PowerPoint format, including more than 400 slides
- Instructor's Manual, containing Objectives, Outlines, and Discussion Questions for each chapter
- Image Bank, including more than 200 illustrations and photographs featured in the text
- Workbook Exercises, tied to specific sections in each chapter

ABOUT THE AUTHORS

Heather Hedrick Fink, MS, RD, CSSD

Heather Hedrick Fink, owner of Nutrition and Wellness Solutions, LLC, is a Registered Dietitian and Board Certified as a Specialist in Sport Dietetics. She completed her undergraduate degree in dietetics as well as her master of science degree in kinesiology at the University of Illinois, Urbana-Champaign. Heather is also certified by the American College of Sports Medicine as a Certified Exercise Physiologist. Heather has been providing nutrition, fitness, and wellness programming to individuals, corporations, and athletic teams for close to 20 years.

Heather's interests and extensive experience are in the areas of wellness, disease prevention, weight management, exercise programming, vegetarian nutrition, and sports nutrition, ranging from the recreational to the ultra-endurance athlete. Her sports nutrition practice includes acting as the sports dietitian for the Indiana University-Purdue University Indianapolis athletic department, as well as working with club teams, individual athletes, trainers, and coaches to optimize their nutrition and hydration strategies. She has appeared on local NBC, CBS, and cable television shows and news broadcasts to educate central Indiana residents on the benefits of a healthy lifestyle. Heather is also the author of the *Absolute Beginner's Guide to Half Marathon Training*. She has been interviewed and quoted in *Women's Day*, *Ladies Home Journal*, and *Newsweek* magazines. Heather is also an accomplished triathlete, duathlete, and marathon runner who has qualified for and competed in the Hawaii Ironman and Boston Marathon.

Alan E. Mikesky, PhD, FACSM

Alan E. Mikesky retired in 2016 and is professor emeritus at the School of Physical Education and Tourism Management at Indiana University-Purdue University Indianapolis (IUPUI), and former Director of the Human Performance and Biomechanics Laboratory. While at IUPUI, he held adjunct appointments with the School of Medicine, Department of Anatomy, and served as research associate at the National Institute for Fitness and Sport in Indianapolis. Dr. Mikesky received his undergraduate degree in biology from Texas A&M University and his master of science degree in physical education with a specialization in exercise physiology from the University of Michigan. He received his doctorate in anatomy/cell biology from the University of Texas Southwestern Medical Center at Dallas, where he studied the adaptations of skeletal muscle to heavy resistance exercise. He is a Fellow of the American College of Sports Medicine (ACSM) and was fitness editor for ACSM's quarterly newsletter, *Fit Society Page*. He has served as a member of the editorial board for the National Strength and Conditioning Association's *Journal of Strength and Conditioning Research* and *Strength and Conditioning Journal*. He is also coauthor of the sixth edition of *Physical Fitness: A Way of Life*, a textbook published by Cooper Publishing Group. His past research focused on the functional improvements and physiological adaptations to various forms of resistance exercise. He has investigated the impact of strength training on gait, balance, incidence of falls, joint proprioception, functional ability, and chronic diseases such as osteoarthritis. In retirement, he will continue to consult and collaborate with former colleagues on research projects and pursue his interests in "entomophagia," which involves the raising and use of insects as food for human consumption.

ACKNOWLEDGMENTS

We would like to thank Jones & Bartlett Learning's Nutrition team for making this fifth edition a reality. Thanks to Sean Fabery and Taylor Maurice on the editorial team for their support, encouragement, and direction for the development of this fifth edition. Thank you to Tina Chen, Molly Hogue, and Brooke Haley on the production team for their tireless efforts in the production of the text, as well as to Merideth Tumas and Shannon Sheehan for their work on obtaining permissions and developing the art program. Thanks to Andrea DeFronzo and the entire Jones & Bartlett marketing and sales teams. Their dedication to our book has helped us surpass our goals.

We are grateful to the reviewers who obviously spent a large part of their valuable time reviewing the previous edition of our text:

John Acquaviva, PhD
Wingate University

Damon Amato, MS, LAT, CSCS
Lasell College

Craig Biwer, MS, CSCS, ACSM-HFS
University of Wisconsin Oshkosh

Peter F. Bodary, PhD
University of Michigan

Lorrie Brilla, PhD, FACSM, FACN, CNS
Western Washington University

Karina Christopher, MS, RD, LD
Eastern Kentucky University

Karen Gibson, DCN, RD, CD, CSSD
Viterbo University

Timothy Harvey, MS, ATC
Mercyhurst University

Tawni Holmes, PhD, RD
University of Central Oklahoma

Janeen R. Hull, MS
Portland Community College

Kathleen M. Laquale, PhD, ATC, LAT, LDN
Bridgewater State University

Simin Levinson, MS, RD, CSSD
Arizona State University

Michael Mangum, PhD
Columbus State University

Kevin Pietro, MS, RD, LD
University of New Hampshire

Connie Tompkins, PhD
University of Vermont

Green T. Waggener, PhD
University of West Florida

Beth A. Young, MA, RD, CSSD, CD
University of Southern Indiana

Their thoughtful, constructive comments provided the feedback necessary to enhance our book with accurate and timely sports nutrition updates.

Finally, we would be remiss not to acknowledge the patience, understanding, and support of our spouses and families. The countless hours spent on this project took away from precious family time and could not have been done without help “picking up the slack” in the other areas of our lives. Without their support, keeping this project on schedule would have never been possible.

SECTION 1

The Basics of Sports Nutrition

This section provides an introduction to sports nutrition, including a review of general nutrition concepts; an overview of digestion and energy metabolism; a thorough explanation of macronutrients, micronutrients, and water and their relation to athletic performance; and, finally, a discussion of nutritional ergogenics.

Chapter 1

Introduction to Sports Nutrition

Chapter 2

Nutrients: Ingestion to Energy Metabolism

Chapter 3

Carbohydrates

Chapter 4

Fats

Chapter 5

Proteins

Chapter 6

Vitamins

Chapter 7

Minerals

Chapter 8

Water

Chapter 9

Nutritional Ergogenics





CHAPTER 1

Introduction to Sports Nutrition

Key Questions Addressed

1. What is sports nutrition?
2. Why study sports nutrition?
3. What are the basic nutrients?
4. How does the body produce energy?
5. What are the Dietary Reference Intakes?
6. What are enriched and fortified foods?
7. What are the basic nutrition guidelines?
8. How should athletes interpret the information on food labels?
9. What are the factors to consider when developing an individualized sports nutrition plan for athletes?
10. How can sports nutrition knowledge be converted into practical applications?



You Are the Nutrition Coach

Jennifer is a 42-year-old tennis player. She states that recently her energy levels have dropped and that she has had a hard time recovering from long tennis matches. She also complains of being “hungry all the time.” The constant hunger has been frustrating because she is trying to maintain her current weight by attempting to control her total daily intake. She has been “eating well” since finding out 2 years ago that she has high cholesterol. She received counseling from a dietitian at the time of her diagnosis and subsequently made major changes in her diet, such as switching to nonfat foods and eliminating dairy. Her goals are to increase her energy levels, decrease recovery time, and create a meal plan that will also be healthy for her husband and three sons.

Question

- What should Jennifer’s top priority be—her high cholesterol, struggle to maintain her weight, constant hunger, low energy levels, or long recovery time?

What is sports nutrition?

Sports nutrition is a specialization within the field of nutrition that partners closely with the study of the human body and exercise science.

sports nutrition A specialty area of study and practice within the field of nutrition.

Sports nutrition can be defined as the application of nutrition knowledge to a practical daily eating plan focused on providing the fuel for physical activity, facilitating the repair and rebuilding process following hard physical work, and optimizing athletic performance in competitive events, while also promoting overall health and wellness. The area of sports nutrition is often thought to be reserved only for “athletes,” which insinuates the inclusion of only those individuals who are performing at the elite level. In this text, the term *athlete* refers to any individual who is regularly active, ranging from the fitness enthusiast to the competitive amateur or professional. Differences may exist in specific nutrient needs along this designated spectrum of athletes, creating the exciting challenge of individualizing sports nutrition plans.

To fully understand and subsequently apply sports nutrition concepts, professionals instructing athletes on

proper eating strategies first need to have a command of general nutrition as well as exercise science. The second step is to gain the knowledge of how nutrition and exercise science are intertwined, under-

standing that physical training and dietary habits are reliant on each other to produce optimal performance. The final step can be considered one of the most critical—the practical application of sports nutrition knowledge to individual athletes participating in a sport or physical activity.

Sports nutrition professionals must be able to teach athletes by putting “book” knowledge into practice with actual food selection and meal planning, while keeping in mind the challenges presented by busy schedules of exercise, competitions, work, school, and other commitments. It is this third step that many professionals lack after graduating from an undergraduate or graduate program in sports nutrition, dietetics, exercise science, or athletic training. Our focus is to review sports nutrition concepts while also translating the information into specific meal plans, recipes, and case study scenarios. Students are encouraged to seek additional opportunities outside the classroom to work with recreational and elite athletes to gain more experience in applying sports nutrition concepts before searching for a job in the “real world.”

Why study sports nutrition?

Sports nutrition has emerged as a recognized specialty area within the field of nutrition. Athletes challenge their bodies on a regular basis through physical training and competitions. To keep up with the physical demands of their activity or sport, athletes need to fuel their bodies adequately on a daily basis. This fueling process requires a specialized approach; therefore, athletes who want to make dietary changes should seek out professionals who are experts in sports nutrition and experienced in developing individualized plans.

Sports nutrition research is providing new and exciting information on a regular basis. It is critical that sports nutrition professionals stay current so they can be **evidence-based practitioners**.

Gone are the days of suggesting dietary practices based on anecdotal observations or experiences. Becoming an evidence-based practitioner requires use of nutrition guidelines and dietary practices that have been documented as being effective through peer-reviewed research. Professionals who have studied sports nutrition, have experience in the field, and continue to stay abreast of the latest nutrition research can prescribe individualized dietary plans that meet basic nutritional needs, enhance performance, and speed recovery in athletes of all sports. Becoming an evidence-based sports nutrition practitioner can lead to an exciting and fulfilling career.



Gaining the Performance Edge

The field of sports nutrition is growing, increasing the demand for qualified sports nutrition professionals. To be considered an “expert” in sports nutrition, a professional must obtain the appropriate education and certification background as well as hands-on experience working with athletes.

evidence-based practitioner An individual whose professional practice is based upon information, guidelines, or interventions that have been shown through research to be safe and effective.

What are the basic nutrients?

Foods and beverages are composed of six nutrients that are vital to the human body for producing energy, contributing to the growth and development of tissues, regulating body processes, and preventing deficiency and degenerative diseases. The six nutrients are carbohydrates, proteins, fats, vitamins, minerals, and water and are classified as **essential** nutrients.

The body requires these nutrients to function properly;

essential A nutrition descriptor referring to nutrients that must be obtained from the diet.

however, the body is unable to endogenously manufacture them in the quantities needed daily, and therefore these nutrients must be obtained from the diet. Carbohydrates, proteins, and

macronutrients These include carbohydrates, proteins, and fats and are classified as such because they have caloric value and the body has a large daily need for them.

micronutrients Vitamins and minerals are classified as micronutrients because the body's daily requirements for these nutrients are small.

fats are classified as **macronutrients** because they have a caloric value and the body needs a large quantity of them on a daily basis. The **micronutrients** include vitamins and minerals; the prefix *micro* is used because the body's daily requirements

for these nutrients are small. Water fits into its own class, and requirements for it vary greatly among individuals. These nutrients will be discussed briefly in this section.

What are carbohydrates?

Carbohydrates are compounds constructed of carbon, hydrogen, and oxygen molecules. Carbohydrates are converted into glucose in the body, providing the main source of fuel (4 calories per gram of carbohydrate) for all physical activity. Carbohydrates are found in a wide variety of foods, including grains, fruits, and vegetables, as well as in the milk/alternative (soy, rice, nut, and other nondairy products) group.

What are proteins?

Amino acids are the building blocks of proteins, which are constructed of carbon, hydrogen, oxygen, and nitrogen molecules.

nonessential A nutrient descriptor referring to nutrients that can be made within the body.

Amino acids can be made within the body (**nonessential**) or obtained from

dietary sources. Proteins are involved in the development, growth, and repair of muscle and other bodily tissues and are therefore critical for recovery from intense physical training. Proteins ensure that the body stays healthy and continues working efficiently by aiding in many bodily processes. Protein can also be used for energy, providing 4 calories per gram; however, it is not used efficiently and therefore is not a source of energy preferred by the body. Proteins are found in a variety of foods, including grains and vegetables, but are mainly concentrated in the milk/alternative as well as meat and beans/alternative (soy products, nuts, seeds, beans, and other nonanimal products) groups.

What are fats?

Fats, like the other macronutrients, are compounds made up of carbon, hydrogen, and oxygen molecules. Fats are also known as lipids, and they come from both plant and

animal sources in our diet. Triglycerides are the most common type of fat. Other fats include cholesterol and phospholipids. With 9 calories per gram, fats are a concentrated source of energy. Fat is primarily used as a fuel at rest and during low-to moderate-intensity exercise. Fats are also involved in providing structure to cell membranes, aiding in the production of hormones, forming the insulation that wraps nerve cells, and facilitating the absorption of fat-soluble vitamins. Fats are concentrated in butter, margarines, salad dressings, and oils, but they are also found in meats, dairy products, nuts, seeds, olives, avocados, and some grain products.

What are vitamins?

Vitamins are a large class of nutrients that contain carbon and hydrogen, as well as possibly oxygen, nitrogen, and other elements. There are two main requirements for a substance to be classified as a vitamin. First, the substance must be consumed exogenously because the body cannot produce it or cannot produce it in sufficient quantities to meet its needs. Second, the substance must be essential to at least one vital chemical reaction or process in the human body. Vitamins do not directly provide energy to

the body; however, some vitamins aid in the extraction of energy from macronutrients. Vitamins are involved in a wide variety of bodily functions and processes that help to keep the body healthy and disease free. Vitamins are classified as either water-soluble (B vitamins and vitamin C) or fat-soluble (vitamins A, D, E, and K), depending on their method of absorption, transport, and storage in the body.

Vitamins are found in nearly all foods, including fruits, vegetables, grains, meat and beans/alternative, milk/alternative, and some fats.

What are minerals?

Minerals are also a large group of nutrients. They are composed of a variety of elements; however, they lack carbon. Minerals have a role in the structural development of tissues as well as the regulation of bodily processes. Physical activity places demands on muscles and bones, increases the need for oxygen-carrying compounds in the blood, and increases the loss of sweat and electrolytes from the body, all of which hinge on the adequate



Gaining the Performance Edge

Each of the six nutrients has a role in the health and proper functioning of the human body. Physical activity places extra demands on the body, increasing the importance of the nutrients' presence in the diet. Many of the nutrients are so critical to optimal athletic performance that the total daily requirements are increased to meet the demands placed on the body. The six basic nutrients each have distinct, but also intertwining, roles, making it critical to consume adequate amounts of each nutrient on a daily basis.

intake and replacement of dietary minerals. Minerals are categorized into major minerals (calcium, sodium, potassium, chloride, phosphorus, magnesium, and sulfur) and trace minerals (iron, zinc, copper, selenium, iodine, fluoride, molybdenum, and manganese) based on the total quantity required by the body on a daily basis. Similar to vitamins, minerals are found in a wide variety of foods, but mainly are concentrated in the meat and beans/alternative and milk/alternative groups.

What is water?

Forming a category of its own, water deserves to be highlighted because of its vital roles within the body. The human body can survive for a much greater length of time without any of the macro- or micro-nutrients than without water. The body is 55–60% water, representing a nearly ubiquitous presence in bodily tissues and fluids. In athletics, water is important for temperature regulation, lubrication of joints, and the transport of nutrients to active tissues. In addition to plain water, water can be obtained from juices, milk, coffee, tea, and other beverages, as well as watery foods such as fruits, vegetables, and soups.

How does the body produce energy?

The body derives its energy from foods ingested daily. Carbohydrates, fats, and proteins are known as the **energy**

energy nutrients Carbohydrates, proteins, and fats serve as the body's source of energy and are considered the energy nutrients.

nutrients because they serve as the body's source for energy. These energy nutrients are quite literally chemicals that have energy trapped within the bonds between the atoms of which they are made. The energy trapped within these nutrients is released when metabolic pathways within the cells break down the foods into their constituent parts, carbon dioxide and water. Some of the energy released is conserved or captured and used to make

adenosine triphosphate (ATP) The molecule that serves as the body's direct source of energy for cellular work.

another high-energy chemical called **adenosine triphosphate (ATP)**. The rest of the energy is lost as heat. ATP is the body's direct source of energy for cellular work. Without a constant source of ATP, muscles would not be able to generate force, and thus athletes would not be able to move or perform any physical activity.

What are the dietary reference intakes?

Several different terms are used to describe the recommendations for macronutrients and micronutrients. The **Recommended Dietary Allowances (RDAs)** were

Recommended Dietary Allowance (RDA) The average daily dietary intake level that is sufficient to meet the nutrient requirements of the overwhelming majority (i.e., 98%) of a healthy population.

Dietary Reference Intakes (DRIs) A newer way to quantify nutrient needs and excesses for healthy individuals. The DRI expands on the older Recommended Dietary Allowance (RDA) and takes into consideration other dietary quantities such as Estimated Average Requirement (EAR), Adequate Intake (AI), and Tolerable Upper Intake Level (UL).

Estimated Average Requirement (EAR) The estimated daily intake level of a vitamin or mineral needed to meet the requirements, as defined by a specified indicator of adequacy, of half of the healthy individuals within a given life stage or gender group.

Adequate Intake (AI) A reference intake for nutrients that is used instead of the Recommended Dietary Allowance. When insufficient scientific evidence is available to calculate an Estimated Average Requirement (EAR), then an AI is used. Similar to the EAR and the Recommended Dietary Allowance (RDA), the AI values are based on intake data of healthy individuals.

Tolerable Upper Intake Level (UL) The highest level of daily nutrient intake that poses no adverse health effects for almost all individuals in the general population.

developed in 1941 by the U.S. National Academy of Sciences. The RDAs were the primary values health professionals used to assess and plan diets for individuals and groups and to make judgments about excessive intakes. The RDAs still exist for many nutrients; however, a newer way to quantify nutrient needs and excesses for healthy individuals has been developed and termed the **Dietary Reference Intakes (DRIs)**. The DRIs expand on the RDAs and take into consideration other dietary quantities such as **Estimated Average Requirement (EAR)**, **Adequate Intake (AI)**, and **Tolerable Upper Intake Level (UL)**. DRIs are continually being reviewed, and reports on various groups of nutrients are published as scientific data are gathered. This comprehensive effort to develop all components of the DRIs is

under the auspices of the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes of the Food and Nutrition Board, the Institute of Medicine, and the National Academy of Sciences of the United States, along



Gaining the Performance Edge

The DRIs encompass the EAR, RDA, AI, and UL for each macronutrient, vitamin, and mineral based on recent research and epidemiological data of healthy populations. As more information and data are discovered, these recommendations will be updated and revised.

Table 1.1**Review of the Nutrient Intake Descriptors**

Descriptor	Definition
Dietary Reference Intake (DRI)	Umbrella term for all nutrient classifications, including RDA, EAR, AI, and UL.
Recommended Dietary Allowance (RDA)	Average daily dietary intake level that is sufficient to meet the nutrient requirements of nearly an entire (i.e., 98%) healthy population. The established RDAs can vary based on life stage, including age; gender; and, if appropriate, pregnancy and lactation.
Estimated Average Requirement (EAR)	Daily intake level of a vitamin or mineral estimated to meet the requirements, as defined by a specified indicator of adequacy in half of the healthy individuals within a life stage or gender group.
Adequate Intake (AI)	Intake recommendation when insufficient scientific evidence is available to calculate an EAR/RDA. AI values are based on intake data of healthy individuals. However, the results of studies regarding the nutrient in question are not conclusive enough or more study is required before an EAR/RDA can be established.
Tolerable Upper Intake Level (UL)	The highest level of daily nutrient intake that poses no adverse health effects for almost all individuals in the general population. At intakes above the UL, the risk of adverse effects increases.

with Health Canada.¹ The definitions of the various DRIs are reviewed in **TABLE 1.1**.

What are enriched and fortified foods?

When grains are milled, the germ and bran are removed. Because the germ and bran contain a majority of the vitamins and minerals in whole grains, the resulting refined product is less nutritious. Refined grain products include white flours, bread, pasta, rice, crackers, and cereals. To prevent deficiency diseases, the Food and Drug Administration (FDA) mandated in 1943 that the nutrients lost during the milling process of wheat, rice, and corn be replaced. The nutrients identified and thus added to refined grain products include thiamin, riboflavin, niacin,

enrichment The addition of vitamins and minerals to refined/processed products to increase their nutritional value.

fortification The process of adding vitamins or minerals to foods or beverages that did not originally contain them.

and iron. The addition of vitamins and minerals to refined products is termed **enrichment**.

Fortification is the addition of a vitamin or mineral to a food or beverage in which it was not originally present.

The first successful fortification program was the addition of iodine to salt in the 1920s to prevent goiter and other iodine deficiency conditions. In general, fortification is not required by the FDA, with the exception of folic acid in grains and vitamin D in milk. Other fortification programs are designed to enhance the quality of a product, such as the addition of vitamin A to milk and other dairy foods, as well as lysine to specific corn products to enhance protein quality. The food industry has the freedom to add any vitamin or mineral to a product. However, the FDA does require companies to show that a dietary insufficiency exists and therefore requires fortification in otherwise standardized products. Some products contain vitamins or minerals not naturally found in the food or beverage, such as added vitamin D and vitamin B₁₂ in soy



Gaining the Performance Edge

Enrichment and fortification of foods and beverages are intended to help individuals meet their daily nutrient needs.

milk. Other products boost existing vitamin or mineral content, such as extra vitamin C added to orange juice. Sport supplements, such as bars and shakes, are highly fortified with a variety of vitamins and minerals. Athletes should check labels to ensure that their total daily consumption of any vitamin or mineral is not in excess of upper dietary limits. For more information about enrichment and fortification, visit the FDA's website at www.fda.gov.

What are the basic nutrition guidelines?

The keys to healthful eating are to consume a diet that provides adequate nutrients to maintain health, includes a variety of foods, is balanced, and is consumed in moderation. Government agencies have developed several tools that provide general healthful eating guidelines that include balance, variety, and moderation to help the American population maintain or improve health. The Dietary Guidelines for Americans and the MyPlate² food guidance system are two such tools that convert scientific evidence into practical applications that Americans can use to eat more healthfully. These general guidelines are applicable to sedentary and athletic individuals alike.

What are the Dietary Guidelines for Americans?

The Dietary Guidelines for Americans, developed jointly by the U.S. Department of Health and Human Services (HHS) and the U.S. Department of Agriculture (USDA), are revised and published every 5 years. The first Dietary Guidelines were published in 1980. The most recent version of the Dietary Guidelines for Americans was published in 2015.³ The guidelines provide science-based advice for people age 2 years and older on dietary and physical activity habits that can promote health and reduce the risk for chronic illnesses and conditions such

as cardiovascular disease, diabetes, and hypertension. A healthful diet that is not excessive in calories, follows the nutrition recommendations contained in the guidelines, and is combined with physical activity should enhance the health of most individuals.

The primary purpose of the Dietary Guidelines is to provide the public with information about nutrients and food components that are known to be beneficial for health and to provide recommendations that can be implemented into an eating and exercise plan. The 2015–2020 Dietary Guidelines cover five interrelated themes. These themes and the key recommendations from the 2015–2020 Dietary Guidelines report are as follows (<http://health.gov/dietaryguidelines/2015/guidelines/executive-summary/>):³

Themes

1. Follow a healthy eating pattern across the lifespan.

All food and beverage choices matter. Choose a healthy eating pattern at an appropriate calorie level to help achieve and maintain a healthy body weight, support nutrient adequacy, and reduce the risk of chronic disease.

2. Focus on variety, nutrient density, and amount.

To meet nutrient needs within calorie limits, choose a variety of nutrient-dense foods across and within all food groups in recommended amounts.

3. Limit calories from added sugars and saturated fats and reduce sodium intake.

Consume an eating pattern low in added sugars, saturated fats, and sodium. Cut back on foods and beverages higher in these components to amounts that fit within healthy eating patterns.

4. Shift to healthier food and beverage choices.

Choose nutrient-dense foods and beverages across and within all food groups in place of less healthy choices. Consider cultural and personal preferences to make these shifts easier to accomplish and maintain.

5. Support healthy eating patterns for all.

Everyone has a role in helping to create and support healthy eating patterns in multiple settings nationwide, from home to school to work to communities.

Key Recommendations

Consume a healthy eating pattern that accounts for all foods and beverages within an appropriate calorie level.

The Dietary Guidelines' Key Recommendations for healthy eating patterns should be applied in their entirety, given the interconnected relationship that each dietary component can have with others.

A healthy eating pattern includes:

- A variety of vegetables from all of the subgroups—dark green, red and orange, legumes (beans and peas), starchy, and other
- Fruits, especially whole fruits
- Grains, at least half of which are whole grains
- Fat-free or low-fat dairy, including milk, yogurt, cheese, and/or fortified soy beverages

- A variety of protein foods, including seafood, lean meats and poultry, eggs, legumes (beans and peas), and nuts, seeds, and soy products

- Oils

A healthy eating pattern limits:

- Saturated fats and trans fats, added sugars, and sodium

Key Recommendations that are quantitative are provided for several components of the diet that should be limited. These components are of particular public health concern in the United States, and the specified limits can help individuals achieve healthy eating patterns within calorie limits:

- Consumption of added sugars to less than 10% of calories per day
- Consumption of saturated fats to less than 10% of calories per day
- Consumption of sodium to less than 2,300 mg per day
- If alcohol is consumed, it should be consumed in moderation—up to one drink per day for women and up to two drinks per day for men—and only by adults of legal drinking age.

Meet the Physical Activity Guidelines for Americans.

Americans of all ages—children, adolescents, adults, and older adults—should meet the *Physical Activity Guidelines for Americans* to help promote health and reduce the risk of chronic disease. Americans should aim to achieve and maintain a healthy body weight (see **FIGURE 1.1**). The

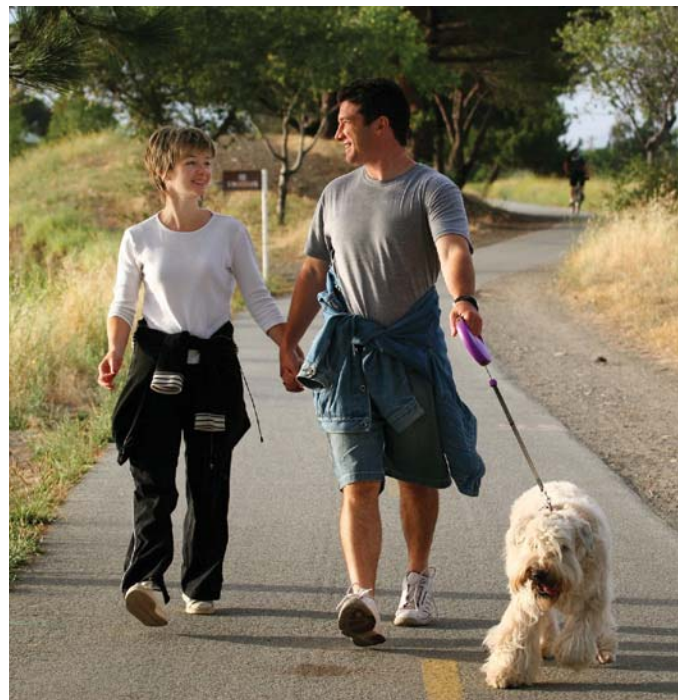


Figure 1.1
Exercising regularly, combined with a diet that does not exceed calorie needs, helps manage weight.

© Galina Barskaya/Shutterstock, Inc.

relationship between diet and physical activity contributes to calorie balance and managing body weight.

Although the Dietary Guidelines listed here were developed with the American population's health in mind, athletes can benefit from implementing the guidelines in their daily nutrition planning. By selecting a variety of nutrient-dense foods, as dictated in the guidelines, athletes can meet their energy, macronutrient, and micronutrient needs for a high level of sport performance. The MyPlate food guidance system can be used to further plan an athlete's daily food intake by practically applying the information in the Dietary Guidelines.

What is the MyPlate food guidance system?

The USDA released the MyPlate food guidance system in 2011 (www.ChooseMyPlate.gov). The USDA's Center for Nutrition Policy and Promotion, established in 1994, developed the MyPlate system to improve the nutrition and well-being of Americans. The MyPlate system (see **FIGURE 1.2**) is a revision of the MyPyramid that was released in 2005. The new icon was developed for two main purposes: (1) to improve the effectiveness in motivating consumers to make healthier food choices and (2) to incorporate the latest nutrition science information into the new system. MyPlate and the Dietary Guidelines for Americans complement each other and can provide basic guidelines and practical applications for healthful eating to improve health and well-being.

The MyPlate website encourages individuals to find their healthy eating style and build it throughout their lifetime. The website reminds individuals that every

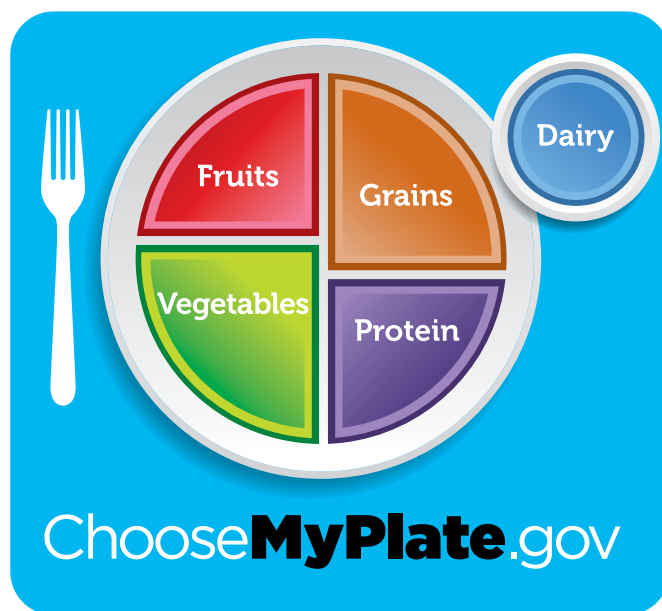


Figure 1.2
Anatomy of MyPlate.

Courtesy of USDA.

food and beverage consumed matters. The right mix of foods and nutrients can help athletes be healthier now and in the future. Long-term health can be accomplished by:

- Focusing on variety, amount, and nutritional value of foods
- Choosing foods and beverages with less saturated fat, sodium, and added sugars
- Starting with small changes to build healthier eating styles
- Supporting healthy eating for everyone

Graphically, the MyPlate food guidance system is a useful and intuitive way for athletes to eat well and improve their health. The MyPlate icon provides a visual representation of a balanced, nutritious meal. The icon is a plate split into four sections, each representing a different type of food (protein, whole grains, fruits, and vegetables). The sections vary in size depending on the recommended portion of each food an athlete should eat. A circle shape next to the plate represents dairy products, especially milk. Each of the food groups are further described in print and electronic format to help consumers make positive nutrition changes. The concepts and main messages in each food category are described briefly in the following paragraphs.

The key message in the grain group of MyPlate is that at least half of the total grains consumed should be from whole grain sources. The goal is to eat three or more ounce-equivalents of whole-grain products each day. Individuals who require more calories will need to consume more than this amount daily. Examples of whole grains include brown rice, bulgur, oatmeal, and whole wheat breads, crackers, and pastas. Consumers can check the food label for the words “whole grain” and the ingredient panel for the word “whole” or “whole grain” before the grain ingredient.

In the fruit group, MyPlate encourages not only consuming the recommended amount of fruit each day, but also consuming a wide variety of fruits. Fruits consumed fresh, canned, frozen, dried, or as 100% juice all count toward the fruit recommendation. However, MyPlate recommends focusing on whole fruits versus fruit juices. This recommendation is made because fruit juices tend to be more calorie dense and contain little fiber compared to whole fruits.

Similar to the fruit category, emphasis is placed not only on consuming enough vegetables daily, but also on choosing different vegetables throughout the week to obtain a greater variety of the nutrients provided from vegetables. The vegetables are listed in five subgroups based on nutrient content: dark green, orange, starchy, dry beans and peas, and other vegetables. The main consumer message with vegetables and fruits is to “make half of your plate vegetables and fruits.”

The protein foods group includes items made from meat, poultry, fish, dry beans or peas, eggs, nuts, and seeds. The key concept for this group is to make choices