Practical Applications in

SPORTS NUTRITION

FIFTH EDITION

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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

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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.

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.

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- Image Bank, including more than 200 illustrations and photographs featured in the text
- Workbook Exercises, tied to specific sections in each chapter

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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 Tumasz 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

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Green T. Waggener, PhD
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Beth A. Young, MA, RD, CSSD, CD
University of Southern Indiana

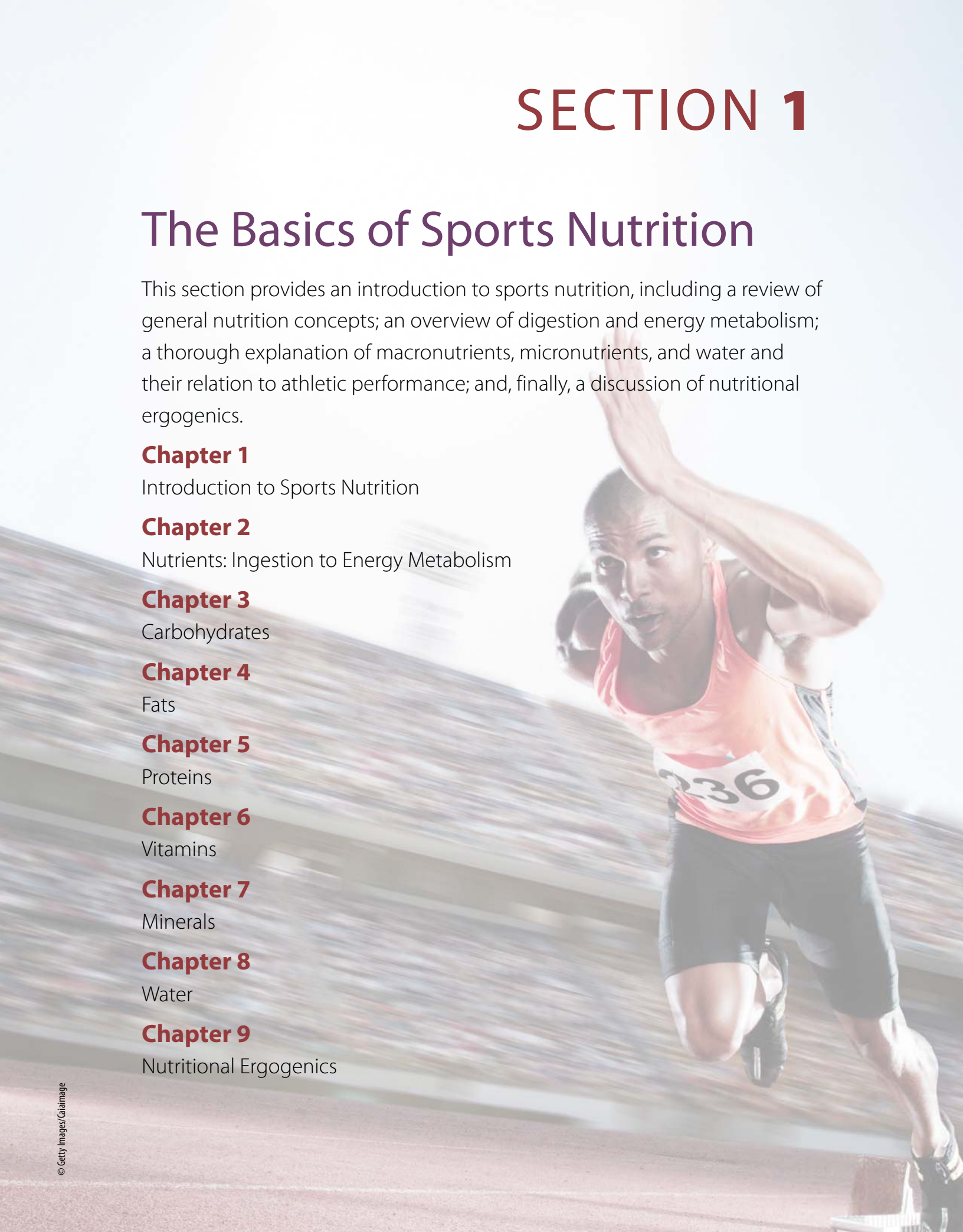
Their thoughtful, constructive comments provided the feedback necessary to enhance our book with accurate and timely sports nutrition updates.

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

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 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.

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

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, understanding 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.

Gaining the Performance Edge

The field of sports nutrition requires a command of general nutrition and exercise science, an understanding of their interrelationship, and the knowledge of how to practically apply sports nutrition concepts.

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 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.

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.

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. 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.

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

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.

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.

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

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 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 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.

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

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

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 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

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.

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

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.

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 B_{12} in soy 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.

Gaining the Performance Edge

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

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 MyPlate[2] 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 that 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.

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 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

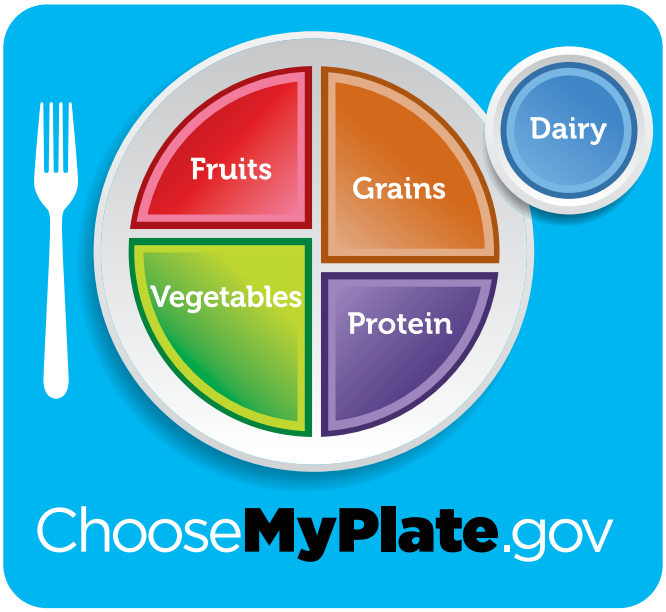


Figure 1.2
Anatomy of MyPlate.
Courtesy of USDA.