Williams'

Nutrition

for Health, Fitness & Sport **12e**

ERIC S. RAWSON | J. DAVID BRANCH | TAMMY J. STEPHENSON

Twelfth Edition

WILLIAMS' NUTRITION

FOR HEALTH, FITNESS & SPORT

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Messiah College

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Old Dominion University

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Dedication

In memory of Melvin H. Williams

We dedicate this twelfth edition to the founding author, Melvin H. Williams. We are honored to carry on the legacy of a friend and respected colleague in the nutrition field.

To Debbie, Christopher, Matthew, and Erica
—*Eric S. Rawson*

To Carol, David, Molly, Anne Randolph, Gracie, and the rest of my family
—*J. David Branch*

To Brian, Bailey, Kylie Mae, and Ansley
—*Tammy J. Stephenson*

and

To our teachers, colleagues, and students
Eric, David, and Tammy

About the Authors

Courtesy of Eric Foster, Bloomsburg University

Eric S. Rawson, PhD, FACSM, CSCS, is Chair and Professor of Health, Nutrition, and Exercise Science at Messiah College in Mechanicsburg, Pennsylvania. Dr. Rawson received his PhD from the University of Massachusetts, Amherst, where he studied under the direction of Dr. Priscilla Clarkson. Over the past two decades, Dr. Rawson's research has focused on the interactions between nutrition and skeletal muscle. In particular, Dr. Rawson has extensively studied the effects of the dietary supplement creatine on muscle and brain function. Dr. Rawson has been an active member in the American College of Sports Medicine (ACSM) since 1996, has served on the ACSM Board of Trustees, on the ACSM Annual Meeting Program Committee, as Chair of the ACSM National Chapter Nutrition Interest Group, and is a past president of the Mid-Atlantic ACSM regional chapter. Dr. Rawson has delivered more than 150 professional presentations, is co-editor of the text *Nutrition for Elite Athletes,* co-author of the eleventh and twelfth editions of *Nutrition for Health, Fitness & Sport,* and has authored/co-authored numerous articles and book chapters. His research has been funded by the National Institutes of Health and various foundations.

Courtesy of Chuck Thomas, University Photographer, Old Dominion University

J. David Branch, earned a BA degree from Furman University, and MS and PhD degrees in Exercise Science from the University of South Carolina. Since 1994, he has been at Old Dominion University in the Department of Human Movement Sciences, where he has taught exercise physiology, exercise testing, research methods, and other courses in the undergraduate and graduate exercise science programs. Prior to that, he was a lecturer at Furman University and worked for many years in a facility specializing in health and fitness testing of South Carolina law enforcement personnel. He is a Fellow in the American College of Sports Medicine. Dr. Branch enjoys reading, running, the beach, spending time with wife Carol, dog Gracie, grand dog Banks, and the accomplishments of his adult children, David and Anne Randolph.

Courtesy of Tammy Stephenson

Tammy J. Stephenson, PhD, received her BS degree in Food Science and Human Nutrition, and PhD in Nutritional Sciences from the University of Kentucky. She has taught a variety of food, nutrition, and wellness courses, including sports nutrition and introductory nutrition, in the Department of Dietetics and Human Nutrition at the University of Kentucky for the past 20 years. Dr. Stephenson serves as Director of Undergraduate Studies for the Dietetics and Human Nutrition degree programs, as Director of the Undergraduate Certificate in Food Systems and Hunger Studies, and as Co-Director of the Undergraduate Certificate in Nutrition for Human Performance. She has been recognized with multiple teaching and advising awards at the university, state, and national levels, including the University of Kentucky Alumni Association's Great Teacher Award (2016) and the Provost Office's Outstanding Teacher Award (2015). Dr. Stephenson is an active member of the Academy of Nutrition and Dietetics, having served as Chair of the Nutrition Educators of Health Professionals practice group. She is also a member of the Sports, Cardiovascular, and Wellness Nutrition practice group of the Academy. Dr. Stephenson is co-author of *Human Nutrition: Science for Healthy Living,* now in its second edition. Outside of the classroom, she enjoys running, yoga, hiking, reading, gardening, watching her daughters play sports, and spending time with her family.

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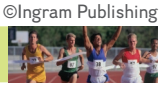

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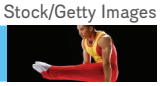

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Preface

According to the World Health Organization, better health is the key to human happiness and well-being. Many factors influence one's health status, including some shared by various government and health agencies, such as safe living environments and access to proper health care. However, in general, one's personal health over the course of a lifetime is dependent more upon personal lifestyle choices, two of the most important being proper exercise and healthy eating.

In the twenty-first century, our love affair with fitness and sports continues to grow. Worldwide, although rates of physical inactivity are still prevalent in developed nations, there are millions of children and adults who are active in physical activities such as bicycling, running, swimming, walking, and weight training. Improvements in health and fitness are major reasons more and more people initiate an exercise program, but many may also become more interested in sports competition, such as age-group road racing; running and walking race competitions have become increasingly popular, and every weekend numerous road races can be found within a short drive. Research has shown that adults who become physically active also may become more interested in other aspects of their lifestyles—particularly nutrition—that may affect their health in a positive way. Indeed, according to all major health organizations, proper exercise and a healthful diet are two of the most important lifestyle behaviors to help prevent chronic disease.

Nutrition is the study of foods and their effects upon health, development, and performance. Over the years, nutrition research has made a significant contribution to our knowledge of essential nutrient needs. During the first part of the twentieth century, most nutrition research focused on identification of essential nutrients and amounts needed to prevent nutrient-deficiency diseases, such as scurvy from inadequate vitamin C. As nutrition science evolved, medical researchers focused on the effects of foods and their specific constituents as a means to help prevent the major chronic diseases, such as heart disease and cancer, that are epidemic in developed countries. *Nutriceutical* is a relatively new term used to characterize the drug, or medical, effects of a particular nutrient. Recent research findings continue to indicate that our diet is one of the most important determinants of our health status. Although individual nutrients are still being evaluated for possible health benefits, research is also focusing on dietary patterns, or the totality of the diet, and resultant health benefits. However, we should note that research relative to the effects of diet, including specific nutrients, on health is complex and dietary recommendations may change with new research findings. For example, as noted later in the text, the guidelines regarding dietary intake of cholesterol have been modified after being in effect for more than 50 years.

Other than the health benefits of exercise and fitness, many physically active individuals are also finding the joy of athletic competition, participating in local sports events such as golf tournaments, tennis matches, triathlons, and road races. Individuals who compete athletically are always looking for a means to improve performance, be it a new piece of equipment or an improved training method. In this regard, proper nutrition may be a very important factor in improving sports performance. Various sports governing agencies indicate today's athletes need accurate sports nutrition information to maximize sports performance. Although the effect of diet on sports and exercise performance was studied only sporadically prior to 1970, subsequently numerous sports scientists and sports nutritionists have studied the performance-enhancing effects of nutrition, such as diet composition and dietary supplements. Results of these studies have provided nutritional guidance to enhance performance in specific athletic endeavors. In the United States, many universities and professional sports teams, such as those in Major League Baseball, the National Hockey League, and the National Football League, employ registered dietitian nutritionists as well as culinary chefs to provide dietary guidance to their athletes.

With the completion of the Human Genome Project, gene therapies are being developed for the medical treatment of various health problems. Moreover, some contend that genetic manipulations may be used to enhance sports performance. For example, gene doping to increase insulin-like growth factor, which can stimulate muscle growth, may be applied to sport.

Our personal genetic code plays an important role in determining our health status and our sports abilities, and futurists speculate that one day each of us will carry our own genetic chip that will enable us to tailor food selection and exercise programs to optimize our health and sports performance. Such may be the case, but for the time being we must depend on available scientific evidence to provide us with prudent guidelines.

Each year thousands of published studies and reviews analyze the effects of nutrition on health or exercise and sports performance. The major purpose of this text is to evaluate these scientific data and present prudent recommendations for individuals who want to modify their diet for optimal health or exercise/sports performance.

Textbook Overview

This book uses a question-answer approach, which is convenient when you may have occasional short periods to study, such as riding a bus or during a lunch break. In addition, the questions are arranged in a logical sequence, the answer to one question often leading into the question that follows. Where appropriate, cross-referencing within the text is used to expand the discussion. No deep scientific background is needed for the chemical aspects of nutrition and energy expenditure, as these have been simplified. Instructors who use this book as a course text may add details of biochemistry as they feel necessary.

Chapter 1 introduces you to the general effects of exercise and nutrition on health-related and sports-related fitness, including the importance of well-controlled scientific research. Chapter 2 provides a broad overview of sound guidelines relative to nutrition for optimal health and physical performance. Chapter 3 focuses on energy and energy pathways in the body, the key to all exercise and sports activities.

Chapters 4 through 9 deal with the six basic nutrients—carbohydrate, fat, protein, vitamins, minerals, and water—with emphasis on the health and performance implications for the physically active individual. Chapters 10 through 12 review concepts of body composition and weight control, with suggestions on how to gain or lose body weight through diet and exercise, as well as the implications of such changes for health and athletic performance. Chapter 13 covers alcohol and caffeine, and other related dietary supplements and ergogenic aids regarding their effects on health and exercise performance. Four appendices complement the text, providing detailed metabolic pathways for carbohydrate, fat, and protein, methods to determine healthy body weight, units of measurement: English System–Metric System equivalents, and approximate energy expenditure by body weight.

New to the Twelfth Edition

The first edition of this textbook, titled *Nutrition for Fitness and Sport,* was published in 1983. As one would expect, much has changed in the fields of nutrition and exercise science over the past 35 years. This edition of the textbook has been updated with the most current research available from evidence-based sources regarding the effects of nutritional choices on health, fitness, and sports performance. New features and updated assessments, including critical thinking questions, make the textbook user-friendly and help students learn and apply content. The new *Training Table* feature is embedded throughout the chapters and provides practical and relevant examples and content on a variety of topics related to physical activity and nutrition. As instructors ourselves, we hope that both faculty and students find the textbook engaging, informative, relevant, and interesting.

As you read through the twelfth edition of the textbook, the following updates have been made.

Chapter 1–Introduction to Nutrition for Health, Fitness, and Sports Performance

- New information on the leading causes of death in the United States with an expanded discussion of those related to diet and/or physical activity
- New Training Tables on current and interesting topics such as *Healthy People 2020* objectives, examples of physical activity options at different intensities, and nutritional quackery
- Reorganization of chapter content to enhance flow and readability
- Physical activity guidelines section updated with the current recommendations and specific examples
- New content on the physical activity habits of Americans with new figure 1.5 map of the United States showing the percentage of the population who are physically inactive in each state
- The most current information available on fitness trackers and heart rate monitors, including a new figure 1.6 showing different options
- Specific recommendations from the *2015-2020 Dietary Guidelines for Americans,* including an expanded discussion of those guidelines
- Updated Prudent Healthy Diet recommendations based on the most current evidence available, including recommendations that focus on the type of fat consumed, versus just limiting all fat; and general recommendations related to protein intake
- An introduction to ergogenic aids and general advice about their use, with specific details embedded throughout subsequent chapters
- New guidelines on evaluating and understanding different types of research studies and making evidence-based recommendations
- A new Application Exercise based on a case-study scenario
- Innovative Critical Thinking Questions that challenge students to go beyond memorizing content, and to truly apply the material
- New and revised references

Chapter 2–Healthful Nutrition for Fitness and Sport

- Many new and revised tables including table 2.1, reorganized to enhance readability, listing nutrients essential or probably essential to humans; table 2.3 listing the Acceptable Macronutrient Distribution Ranges (AMDRs) for adults; and table 2.4 providing key information about the different food groups and sample serving size equivalents
- New Training Tables on topics including food sources of empty calories, healthy eating on a budget, and limiting sodium intake
- Revised section with new information on how dietary recommendations are set, and a new figure 2.2 showing the relationship between RDAs, AIs, ULs, and others
- New MyPlate content
- Condensed content on the Food Exchange System and an expanded discussion of carbohydrate counting as an alternative
- Updated figure 2.5 demonstrating the concept of nutrient density when comparing two products
- Specific dietary advice based on the most currently available literature and recommendations from evidence-based sources, including significantly revised sections on whole grains, dietary fat, added sugars, and vegetarianism
- New figure 2.11 showing the most current Nutrition Facts panel approved by the U.S. Food and Drug Administration (FDA), with text discussions on what changes were made and advice pertaining to the use of those labels

- New content related to classification and monitoring of dietary supplements with practical advice on how supplements can be a healthy addition to a well-balanced diet
- Introduction of key concepts of sports nutrition with practical recommendations and guidance, including specific examples of precompetition meals
- A new Application Exercise based on a case-study scenario
- New Critical Thinking Questions
- New and revised references

Chapter 3—Human Energy
- Enhanced discussion of techniques to measure physical activity and energy expenditure, including the use of various commercial apps
- Updated figures and images
- New and revised references

Chapter 4—Carbohydrates: The Main Energy Food
- Removal of Food Exchanges content
- New data on the effectiveness of carbohydrate mouth rinse on resistance exercise performance
- New Training Tables on topics such as simplifying carbohydrate recommendations, carbohydrate recommendations based on energy expenditure, and optimizing dietary fiber intake
- Updated carbohydrate Key Concepts
- Updated data on ergogenic aspects of carbohydrate
- New data on the effects of sugar and fiber ingestion on health
- Updated information on gluten-free diets
- New information on low FODMAP diets
- New and revised references

Chapter 5—Fat: An Important Energy Source during Exercise
- New information on dietary cholesterol intake from the *2015–2020 Dietary Guidelines for Americans*
- New data on the effects of low-carbohydrate, high-fat diets in endurance athletes
- New Training Tables on the topics of ketogenic diets and endurance exercise performance, low-fat versus high-fat diets for weight loss, the coconut oil dietary fad, the International Olympic Committee (IOC) dietary supplement consensus for athletes, and dietary guidelines to reduce or maintain serum lipid levels
- Updated information on the benefits of a low-fat diet on breast cancer
- New data on the effects of intermittent fasting on weight loss and health
- New data on the effects of omega-3 fat intake on cognitive and muscle functions and health
- New research on ketone supplements
- Updated Key Concepts
- New links to calculators that assess cardiovascular disease risk
- Updated information on low-fat diets and weight loss
- New data on the interactions between different fats, carbohydrate, and heart disease
- New Application Exercise
- New and revised references

Chapter 6—Protein: The Tissue Builder
- Update on the importance of dietary protein during weight loss
- New information on the postexercise anabolic window
- New Training Tables on protein recommendations and creatine supplementation for athletes
- New information on IOC consensus on dietary supplements that can improve performance or alter body composition
- Updated information on creatine supplementation and recovery from injury
- New data on the effects of creatine supplementation on cognitive processing, concussion, and brain health
- Updated information on the benefits of beta-alanine supplements
- New and revised references

Chapter 7—Vitamins: Fat-Soluble, Water-Soluble, and Vitamin-Like Compounds
- Relevant content on the vitamins with updates based on the most current position paper from the Academy of Nutrition and Dietetics and the American College of Sports Medicine
- Expanded overview of vitamins with a revamped table 7.1 showing a summary of each vitamin
- Updated content with the latest research on the effects of specific vitamins on health and physical activity performance
- New photos to break up the text and provide a visual of good food sources for each vitamin
- A new figure 7.5 showing the role of folate and vitamin B12 in red blood cell formation
- Two new Training Tables, one listing the classification of fat-soluble and water-soluble vitamins and vitamin-like substances, and another providing practical advice about how to read a Supplement Facts label and make prudent vitamin supplement choices
- Specific information on the health aspects of vitamin supplements now integrated within the discussion of each vitamin
- New Multiple Choice and Critical Thinking Questions
- New and revised references

Chapter 8—Minerals: The Inorganic Regulators
- Relevant content on the minerals with updates based on the most current position paper from the Academy of Nutrition and Dietetics and the American College of Sports Medicine
- Expanded overview of minerals with additional content on the difference between major, trace, and possibly essential minerals, including new tables 8.2 and 8.4 summarizing each of the major and trace minerals
- Updated content with the latest research on the effects of specific minerals on health and physical activity performance
- New photos to break up the text and provide a visual of good food sources for each mineral
- Four new Training Tables on topics including factors that increase or decrease calcium absorption, how to reduce one's risk for osteoporosis and improve bone health, common signs and symptoms of iron-deficiency anemia, and a summary of two possibly essential minerals
- New table 8.5 differentiating factors that influence iron bioavailability and an expanded section on iron-deficiency anemia
- A new Application Exercise is provided for students to evaluate minerals with potential ergogenic benefits and to develop informational handouts on one of those minerals
- New Multiple Choice and Critical Thinking Questions
- New and revised references

Chapter 9—Water, Electrolytes, and Temperature Regulation
- Revised and updated figures and tables
- Addition of the new American Heart Association blood pressure guidelines
- Five new Training Tables covering the topics of temperature regulation and heat loss; key highlights of the ACSM position stand on exercise and fluid replacement; symptoms of hyponatremia; recommendations pertaining to fluid and carbohydrate intake before, during, and after exercise; and selected benefits of acclimatization
- New Application Exercise
- New Multiple Choice and revised Critical Thinking Questions
- New and revised references

Chapter 10—Body Weight and Composition for Health and Sport
- Modified and updated figures and tables
- Five new Training Tables covering the symptoms of the metabolic syndrome, symptoms of anorexia nervosa, *DSM-V* criteria for bulimia nervosa, behaviors associated with binge eating disorder, and other selected disordered eating or body image disorders
- New Application Exercise
- New Multiple Choice questions
- New and revised references

Chapter 11—Weight Maintenance and Loss through Proper Nutrition and Exercise
- Many new or modified figures and tables
- New Nutrition Facts label designed according to the *2015–2020 Dietary Guidelines for Americans*
- New Training Table listing suggestions to reduce overeating and increase physical activity
- New Application Exercise
- New Multiple Choice questions and revised Critical Thinking questions
- New and revised references

Chapter 12—Weight Gaining through Proper Nutrition and Exercise
- Many new and revised figures and tables
- Expanded discussion of nutrient timing
- Discussion of the proposed role of β-hydroxy-β-methylbutyrate (HMB) in increased muscle protein synthesis and decreased catabolism
- Additional text on the importance of concentric and eccentric contractions to induce muscle hypertrophy
- Expanded discussion of the importance of consistency in time of day for resistance training
- Modified Figure 12.15 to emphasize muscle fiber hypertrophy as the dominant mechanism for muscle growth
- New Table 12.4 listing selected health effects of resistance training
- Discussion of potential cell-signaling "competition" between high volume aerobic and high volume resistance training which might attenuate muscle hypertrophy
- New Application Exercise
- New Multiple Choice questions
- New and revised references

Chapter 13—Nutritional Supplements and Ergogenic Aids
- Many new and updated figures and tables
- Revised Table 13.2 to include effects of alcohol on brain function
- Table 13.3 listing selected cardiovascular diseases and symptoms that are associated with excessive alcohol consumption
- Table 13.4 listing possible effects of alcohol consumption on weight gain
- Table 13.5 listing proposed mechanisms of light-to-moderate alcohol consumption on cardiovascular health
- Table 13.7 listing effects of caffeine on selected performance tasks
- Table 13.8 listing caffeine content in selected energy drinks and shots with descriptive information on caffeine content for 408 energy drinks and 86 energy shots
- Discussion of ergogenic mechanisms of dietary nitrates
- New Application Exercise
- New Multiple Choice questions
- New and revised references

Enhanced Pedagogy

Each chapter contains several features to help enhance the learning process. **Learning Outcomes** are presented at the beginning of each chapter, highlighting the key points and serving as a studying guide for students and an assessment tool for faculty. **Key Terms** also are listed at the beginning of each chapter and definitions are included both in the chapter and in the glossary. A new Training Table feature has also been added to this edition of the textbook. The **Training Tables** emphasize practical and current concepts relevant to each chapter. **Key Concepts** provide a summary of essential information presented throughout each chapter. Bulleted lists are utilized to help students focus on the key information. **Check for Yourself** includes individual activities, such as checking food labels at the supermarket or measuring one's own body fat percentage. The **Application Exercise** at the end of each chapter may require more extensive involvement, such as a case study or a survey of an athletic team. **Multiple Choice Questions** and **Critical Thinking Questions** are also included at the end of each chapter for students to self-assess their knowledge of the chapter content. The Critical Thinking Questions require students to apply the knowledge they've learned in each chapter.

The reference lists have been completely updated for this edition with the inclusion of hundreds of new references that provide the scientific basis for the new concepts or additional support for those concepts previously developed. These references provide greater in-depth reading materials for the interested student. Although the content of this book is based on appropriate scientific studies, a reference-citation style is not used, that is, each statement is not referenced by a bibliographic source. However, names of authors may be used to highlight a reference source where deemed appropriate.

This book is designed primarily to serve as a college text in professional preparation programs in dietetics and human nutrition, health and physical education, exercise science, athletic training, sports medicine, and sports nutrition. It is also directed to the

physically active individual interested in the nutritional aspects of physical and athletic performance.

Those who desire to initiate a physical training program may also find the nutritional information useful, as well as the guidelines for initiating a training program. This book may serve as a handy reference for coaches, trainers, and athletes. With the tremendous expansion of youth sports programs, parents may find the information valuable relative to the nutritional requirements of their active children.

In summary, the major purpose of this book is to help provide a sound knowledge base relative to the role that nutrition, complemented by exercise, may play in the enhancement of both health and sports performance. We hope the information provided in this text will help inspire the reader to make health-promoting choices related to diet and physical activity.

Acknowledgments

This book would not be possible without the many medical/health scientists and exercise/sports scientists throughout the world who, through their numerous studies and research, have provided the scientific data that underlie its development. We are fortunate to have developed a friendship with many of you, and we extend our sincere appreciation to all of you. We would like to thank the following nutrition educators who reviewed this text.

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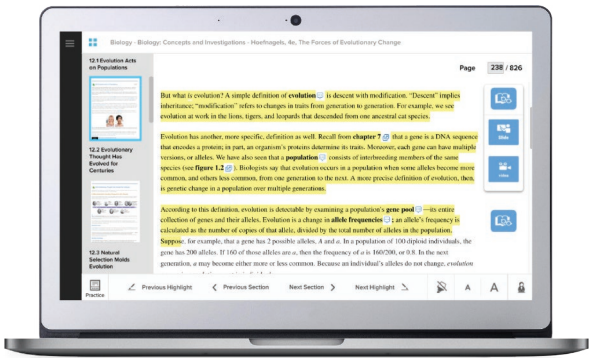

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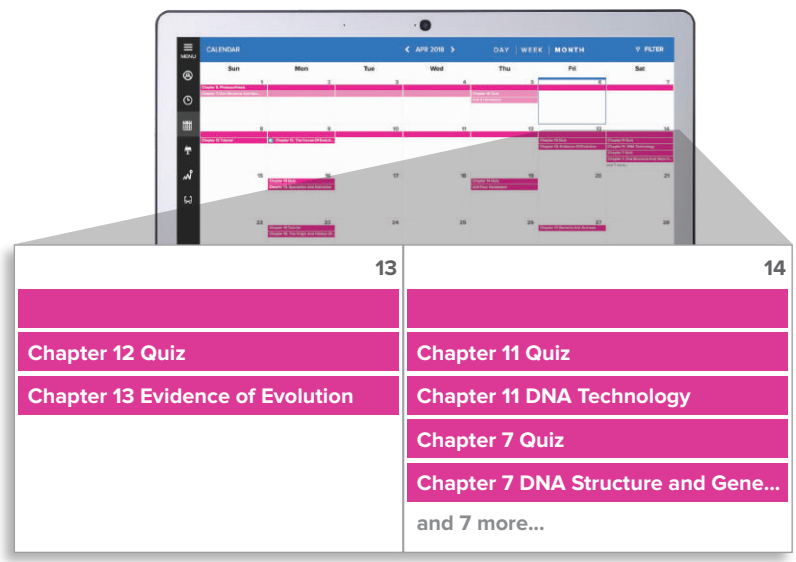

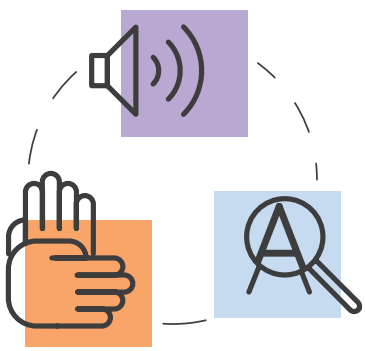

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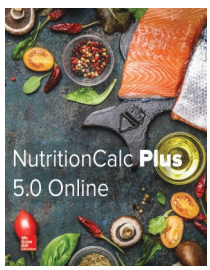

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NutritionCalc Plus is a powerful dietary analysis tool featuring more than 35,000 foods from the ESHA Research nutrient database, which is comprised of data from the latest USDA Standard Reference database, manufacturer's data, restaurant data, and data from literature sources. NutritionCalc Plus allows users to track food and activities, and then analyze their choices with a robust selection of intuitive reports. An updated mobile-friendly interface has been developed according to WCAG guidelines for further accessibility.

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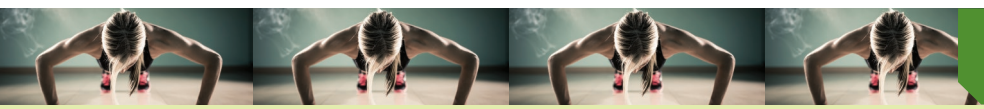
Introduction to Nutrition for Health, Fitness, and Sports Performance



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CHAPTER ONE

LEARNING OUTCOMES

After studying this chapter, you should be able to:

1. List the leading causes of death in the United States and identify those that may be related to lifestyle factors, including diet and/or physical activity.
2. Explain the importance of genetics, diet, and physical activity in the determination of optimal health and successful sport performance.
3. Describe the components of health-related fitness and identify the potential health benefits associated with each.
4. Compare and contrast sports-related fitness and health-related fitness.
5. Summarize the seven key principles of exercise training.
6. Explain the importance of diet choices and proper nutrition in promoting optimal health and wellness.
7. Summarize the role of dietary supplements as ergogenic aids to promote sports performance.
8. Define nutritional quackery and provide strategies that can be utilized to determine whether claims regarding a dietary supplement are valid.
9. Explain what types of research have been used to evaluate the relationship between nutrition and health or sport performance, and evaluate the pros and cons of each type.

KEY TERMS

antipromoters
cytokines
doping
epidemiological research
epigenetics
epigenome
ergogenic aids
exercise
experimental research
health-related fitness
high-intensity interval training (HIIT)
malnutrition
meta-analysis
nutrient
nutrition
physical activity
physical fitness
promoters
Prudent Healthy Diet
quackery
risk factor
Sedentary Death Syndrome (SeDS)
sports nutrition
sports-related fitness
sports supplements
structured physical activity
unstructured physical activity

Introduction

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There are two major focal points of this book. One is the role that nutrition, complemented by physical activity and exercise, may play in the enhancement of one's health status. The other is the role that nutrition may play in the promotion of fitness and sports performance. Many individuals today are physically active, and athletic competition spans all ages. Healthful nutrition is important throughout the life span of the physically active individual because suboptimal health status may impair training and competitive performance. In general, as we shall see, the diet that is optimal for health is also optimal for exercise and sports performance.

Nutrition, fitness, and health. Health care in most developed countries has improved tremendously over the past century. With modern health care, once deadly diseases are no longer a major source of concern. Rather, the treatment and prevention of chronic diseases, such as diabetes and obesity, are now the emphasis of much research and health recommendations.

Table 1.1 lists the ten leading causes of death in the United States in 2015 and the approximate percentage of deaths associated with each. For both males and females, heart disease is the leading cause of death, accounting for death in nearly one in four Americans. Of the leading causes of death, risk for heart disease, cancer, stroke, Alzheimer's disease, diabetes, and kidney disease have been linked to a person's diet and physical activity habits. According to the U.S. Department of Health and Human Services (HHS), unhealthy eating and physical inactivity are primary contributors to death in the United States.

TABLE 1.1 Leading causes of death in the United States (2015)

	Approximate percentage of deaths
Heart disease*	23.4
Cancer*	22.0
Chronic lower respiratory infections	5.7
Unintentional injuries (accidents)	5.4
Stroke*	5.2
Alzheimer's disease*	4.1
Diabetes mellitus*	2.9
Influenza and pneumonia	2.1
Kidney disease*	1.8
Suicide	1.6
All other causes	25.8

*Cause of death for which diet and/or physical activity may impact risk.

Source: National Center for Health Statistics: *Health, United States, 2015.* www.cdc.gov/nchs/fastats/deaths.htm. Accessed: February 15, 2018.

In addition to lifestyle choices, family history also impacts risk for chronic disease. According to Simopoulos, all diseases have a genetic predisposition. The Human Genome Project, which deciphered the DNA code of our 80,000 to 100,000 genes, has identified various genes associated with many chronic diseases, such as breast and prostate cancer. Genetically, females whose mothers had breast cancer are at an increased risk for breast cancer, while males whose fathers had prostate cancer are at an increased risk for prostate cancer.

Completion of the Human Genome Project is believed to be one of the most significant medical advances of all time. Although multiple genes are involved in the etiology of most chronic diseases

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