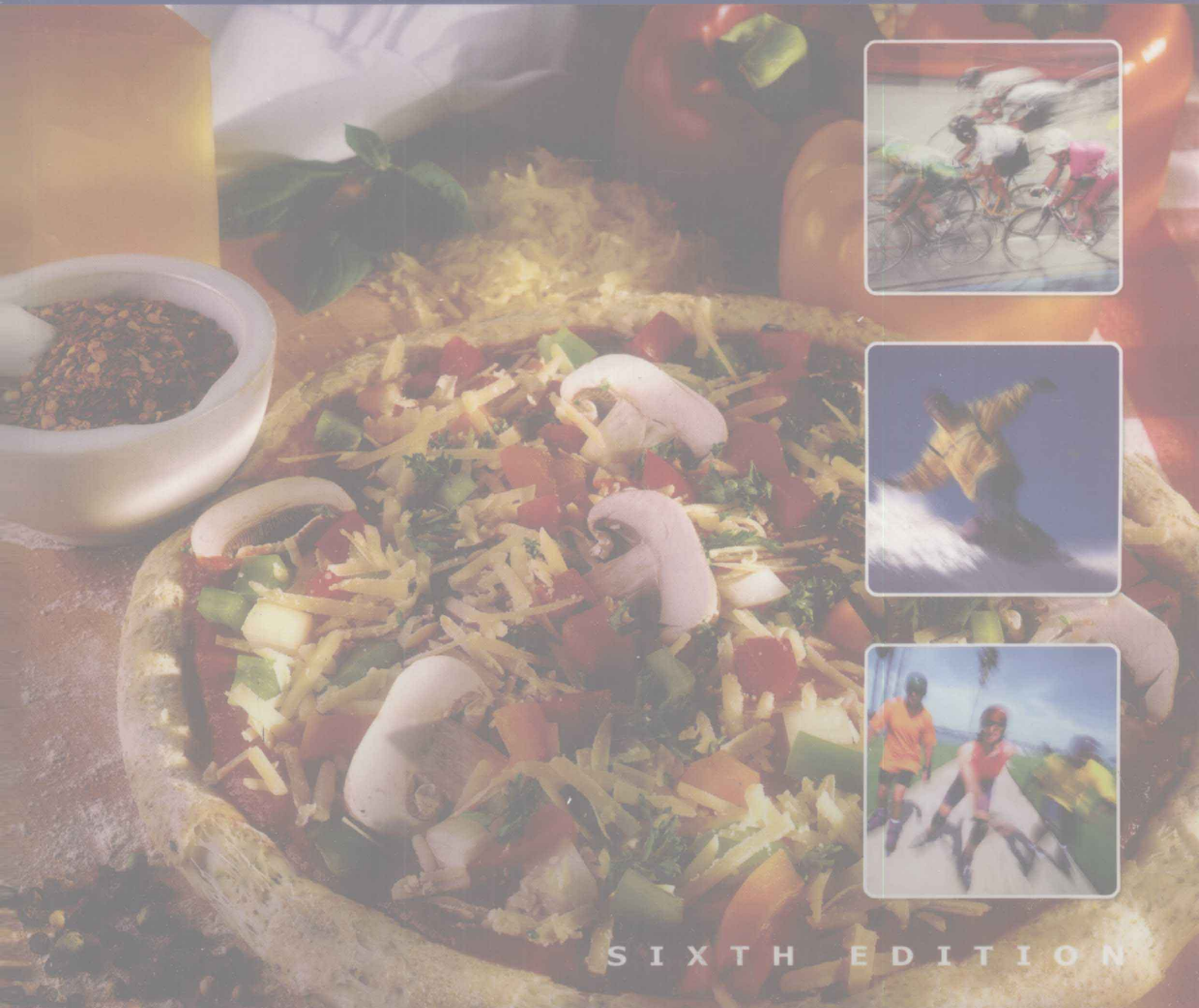


NUTRITION

FOR HEALTH, FITNESS & SPORT



SIXTH EDITION

Melvin H. Williams

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**FOR HEALTH, FITNESS
& SPORT**

Melvin H. Williams

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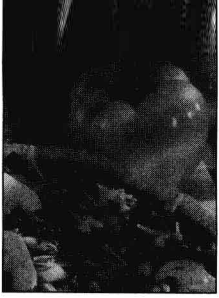
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Preface

In this new millennium, our love affair with fitness and sports continues to grow. Worldwide, more of us participate in physical activities such as aerobic dancing, bicycling, golf, running, swimming, tennis, weight training, and a host of other recreational activities and sports. Improvement in health and fitness is one of the major reasons that more and more people initiate an exercise program. Research has shown that adults who become physically active also may become more interested in other aspects of their life styles—particularly nutrition—that may affect their health in a positive way.

Nutrition is the study of foods and their effects upon health, development, and performance. Although a relatively young science, 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. More recently, medical researchers have focused on the effects of foods and their specific constituents as a means to help prevent 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.

Other than the health benefits of exercise and fitness, many physically active individuals also are finding the joy of athletic competition, participating in local sport events such as golf tournaments, tennis matches, 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 exercise and sport performance. Although the effect of diet on exercise performance had been studied only sporadically prior to 1970, subsequently numerous sport scientists and sport nutritionists have studied the effects of nutrition, such as diet composition and dietary supplements, on exercise and

sport performance. Results of these studies have provided nutritional guidance to enhance performance in specific athletic endeavors.

Each year literally 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/sport performance.

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 upon energy and energy pathways in the body, the key to all exercise and sport 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. Numerous appendixes complement the text, providing data on caloric expenditure during exercise, methods to determine body composition, nutritional value of fast foods, and other information pertinent to physically active individuals.

Key concepts are presented at the beginning of each chapter, a kind of preliminary summary. These can be used for previewing the chapter and for reinforcement once the chapter has been completed. Key terms also are listed at the beginning of the chapter and highlighted, in most cases, when they are first defined in the text. Although some terms may appear in the text before they are defined, a thorough glossary includes the key terms as well as other terms warranting definition.

The bibliographic references are of three types. *Books* listed provide broad coverage of the major topics in the chapter. *Reviews* are detailed analyses of selected topics, usually involving a synthesis and analysis of specific research studies. The *specific studies* listed are primary research studies. The reference lists have been completely updated for this sixth edition, with the addition of over 480 new reviews and 380 new specific studies, and 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.

Your involvement in practical activities is encouraged. There are a number of opportunities for the reader to get actively involved: estimation of your percent body fat, estimation of the number of Calories to maintain body weight, designing a 1,200-Calorie diet, calculating the caloric expenditure for a given exercise, or initiating a sound exercise program based upon contemporary principles of exercise prescription.

This book is designed primarily to serve as a college text in professional preparation programs in health and physical education, exercise science, 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 may 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 sport performance. Hopefully, the information provided in this text will help the reader develop a more healthful and performance-enhancing diet. Bon appetit!

Supplementary Materials

Nutrition for Health, Fitness, & Sport is accompanied by a series of useful supplements designed to aid students and professors:

- A text-specific web site (www.mhhe.com/williams) that offers online support materials for professors and students. Features include an Instructor's Manual, interactive student quizzes, and links to key nutrition sites.
- *Nutrition 2002 Transparencies* include illustrations from this and other McGraw-Hill nutrition texts and are available to qualified adopters.
- *Computerized Testing Software* includes true/false and multiple choice questions on a hybrid CD.
- See your McGraw-Hill sales representative about other nutrition-related supplements.

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The reviewers of the five previous editions have played an integral role in the changes that are made, and this edition is no exception. I wish to extend a special note of appreciation to those who reviewed the fifth edition text, and the sixth edition manuscript.

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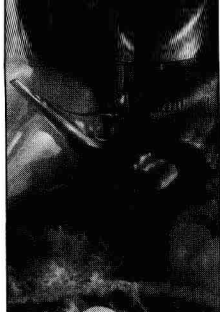
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Melvin H. Williams
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Introduction to Nutrition for Health, Fitness, and Sports Performance



KEY CONCEPTS

- The two primary determinants of health status are genetics and lifestyle.
- Six of the ten chronic diseases in the United States and Canada (heart diseases, cancer, stroke, lung diseases, diabetes, and liver diseases) may be prevented by appropriate lifestyle behaviors.
- Two of the key health promotion objectives set by the U.S. Department of Health and Human Services in *Healthy People 2010* are increased levels of physical activity and reduced levels of overweight and obesity.
- Health-related fitness includes a healthy body weight, cardiovascular-respiratory fitness, adequate muscular strength and endurance, and sufficient flexibility.
- Physical inactivity may be dangerous to your health. As documented in the *Surgeon General's Report on Physical Activity and Health*, exercise, as a form of physical activity, is becoming increasingly important as a means to help prevent, and even treat, many chronic diseases.
- One of the key points of the Surgeon General's report is that physical activity need not be strenuous to achieve health benefits, but additional benefits may be gained through greater amounts of physical activity.
- The primary purpose of the food we eat is to provide us with nutrients essential for the numerous physiological and biochemical functions that support life.
- Poor eating habits span all ages. The *Healthy People 2010* report notes that poor nutrition is a major health problem in the United States.
- Basic guidelines for A Healthy North American Diet include maintenance of proper body weight and consumption of a wide variety of natural foods high in complex carbohydrates and low in fat.
- Although both proper exercise and sound nutrition habits may confer health benefits separately, health benefits may be maximized when both healthy exercise and nutrition lifestyles are adopted.
- Success in sports is primarily dependent on genetic endowment and proper training, but nutrition also can be an important contributing factor.

KEY TERMS

A Healthy North American Diet 11
antipromoters 10
chronic-training effect 16
dietary supplement 17
doping 20
ergogenic aids 18
epidemiological research 24
exercise 4
experimental research 25
health-related fitness 4
malnutrition 15
meta-analysis 27
nutrient 9
nutrition 9
physical activity 4
physical fitness 3
promoters 10
quackery 20
risk factor 3
sports nutrition 13
sports-related fitness 13
structured physical activity 4
unstructured physical activity 4

- Studies reveal that although athletes desire to eat a diet that may enhance sport performance, their knowledge of nutrition is inadequate, and many are not meeting the dietary recommendations of sports nutritionists.
- A dietary supplement is a food product, added to the total diet, that may contain vitamins, minerals, herbs or botanicals, amino acids, metabolites, constituents, extracts, or any combination of the above.
- Although some people may need dietary supplements for various reasons, the use of supplements should not be routine practice for most individuals. Obtain nutrients through natural foods.
- Probably the most prevalent ergogenic aids used to increase sport performance are those classified as nutritional, for theoretical nutritional aids may be found in all six classes of nutrients.
- There appears to be no sphere of nutrition in which faddism, misconceptions, ignorance, and quackery are more obvious than with dietary supplements marketed to athletes.
- There are a number of guidelines to help identify quackery and false claims of dietary supplements, but one of the critical points to consider is if the claim simply appears to be too good to be true.
- The best means to counteract nutritional quackery in sports is to possess a good background in nutrition.
- Prudent nutritional recommendations for enhancement of health or athletic performance are based on reputable research.

Introduction

There are two major focal points of this book. One is the role that nutrition, complemented by physical activity and exercise, may play in determining one's health status. The other is the role that nutrition may play in the enhancement of fitness and sports performance. People of all ages 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.

Nutrition, fitness, and health. At a national level, the health care of Americans and Canadians has improved tremendously over the past century. Primarily because of the dedicated work of medical researchers, we no longer fear the scourge of acute infectious diseases such as polio, smallpox, or tuberculosis. However, we have become increasingly concerned with the treatment and prevention of chronic diseases. Six of the ten leading causes of death in the United States are chronic diseases. Given with rank in parentheses, they include: (1) diseases of the heart, (2) cancer, (3) stroke, (4) chronic lung diseases, (7) diabetes, and (10) chronic liver disease and cirrhosis. These diseases cause over 80 percent of all deaths, and this figure is destined to rise as the U.S. population becomes increasingly older, particularly during the first quarter of this century when the baby boomers of the 1940s and 1950s reach their senior years.

As mentioned previously, the two primary factors that influence one's health status are genetics and lifestyle. Most chronic diseases have a genetic basis. Medical geneticists working on the Human Genome Project, a major international initiative to decipher the three-billion-unit code of DNA in our 80,000 to 100,000 genes, have already identified genes associated with many chronic diseases, such as breast, colon, and prostate cancer; severe obesity; and diabetes. Your risk of getting a disease is increased if one of your parents had it. For example, the normal risk of getting type II diabetes in the general population is about 3–7 percent, but the chances increase to 10–15 percent if one of your parents had the disease. Your risk increases even more if a second parent or your brother or sister had the disease. The Human Genome Project is now complete, and Shreeve and Kasmauski suggest that new treatments, and possibly cures, for some diseases won't be far behind.

Nevertheless, healthful lifestyle behaviors will still be important health determinants. For example, LaRosa indicates that nonpharmacological interventions (such as diet and exercise) are important even with the current use of powerful medicines to treat chronic health problems, such as heart disease. Diet and exercise may not only augment the effect of these drugs, but also may help prevent heart disease in the first

place. In a similar vein, a review by Cousins suggests that research involving nutritional regulation of gene expression may help identify specific nutrients in the diet that may either promote or repress gene expression. For example, nutrients may be identified that repress expression of a specific cancer gene. Additionally, Shephard and Shek indicate that exercise may induce various chemical changes, such as hormone secretion, in the body that may repress gene expression for certain cancers. If your personal genetic code indicates that your genetic profile predisposes you to certain forms of cancer, a preventive diet and an exercise plan may be individualized for you.

Treatment of chronic diseases is very expensive. Foreseeing a financial health care crisis associated with an increasing prevalence of such diseases during the first half of this century, most private and public health professionals have advocated health promotion and disease prevention as the best approach to address this potential major health problem. For example, James Rippe, a renowned physician, has coined the term *Lifestyle Medicine* (also the title of his new book) to characterize this focus on health promotion behaviors to help prevent disease. The United States Public Health Service, beginning in the 1980s, has published a series of reports designed to increase the nation's health, the latest version entitled *Healthy People 2010: National Health Promotion/Disease Prevention Objectives*. *Physical activity and overweight and obesity* are two major focus areas in *Healthy People 2010*. In these reports, lifestyle behaviors that promote health and reduce the risk of chronic diseases are basically under the control of the individual. For the full *Healthy People 2010* report, consult www.health.gov/healthypeople.

Over the years, scientists in the field of epidemiology have identified a number of lifestyle factors considered to be health risks; these lifestyle factors are known as risk factors. A **risk factor** is a health behavior that has been associated with a particular disease, such as cigarette smoking being linked to lung cancer. As we shall see, exercise and proper nutrition, both individually and combined, may reduce many of the risk factors associated with the development of chronic diseases.

These healthful benefits will be addressed at appropriate points throughout the book.

Nutrition, fitness, and sport. Sport is now most commonly defined as a competitive athletic activity requiring skill or physical prowess, for example, baseball, basketball, soccer, football, racing, wrestling, tennis, and golf. As with health status, athletic ability and subsequent success in sport are based primarily upon two factors: natural genetic endowment and state of training. To be successful at high levels of competition, the athlete must possess the appropriate biomechanical, physiological, and psychological genetic characteristics associated with success in a given sport, and these genetic characteristics must be developed maximally through proper biomechanical, physiological, and psychological coaching and training.

Specialized exercise training is the major means to improve athletic performance. Athletes at all levels of competition, whether for an Olympic gold medal or an age-group award in a local road race, are always interested in ways to improve their performance and gain an edge on the competition. Currently, there is nothing an athlete can do to modify his or her genetic endowment, but training programs have become more intense and individualized, resulting in significant performance gains, and world records continue to improve.

Proper nutrition also is an important component in the total training program of the athlete. Certain nutrient deficiencies can seriously impair performance, while supplementation of other nutrients may help delay fatigue and improve performance. Over the past four decades, research has provided us with many answers about the role of nutrition in athletic performance, but unfortunately some findings have been misinterpreted or exaggerated so that a number of misconceptions still exist.

The purpose of this chapter is to provide a broad overview of the role that exercise and nutrition may play relative to health, fitness, and sport, and how prudent recommendations may be determined. More detailed information regarding specific relationships of nutritional practices to health and sports performance is provided in subsequent chapters.

Nutrition, Exercise, and Health-Related Fitness

Physical fitness may be defined, in general terms, as a set of abilities individuals possess to perform specific types of physical activity. The development of physical fitness is an important concern of many professional health organizations, including the American Alliance for Health, Physical Education, Recreation, and Dance (AAHPERD), which has categorized fitness components into two different categories. In general, these two categories may be referred to as health-related fitness and sports-related fitness. Both types of fitness may be influenced by nutrition and exercise.

Exercise and Health-Related Fitness

What is health-related fitness?

As mentioned above, one's health status is influenced strongly by hereditary predisposition and lifestyle behaviors, particularly appropriate physical activity and a high-quality diet. As we shall see in various sections of this book, one of the key factors in preventing the development of chronic disease is maintaining a healthful body weight.

Proper physical activity may certainly improve one's health status by helping to prevent excessive weight gain, but it may also enhance other facets of health-related fitness