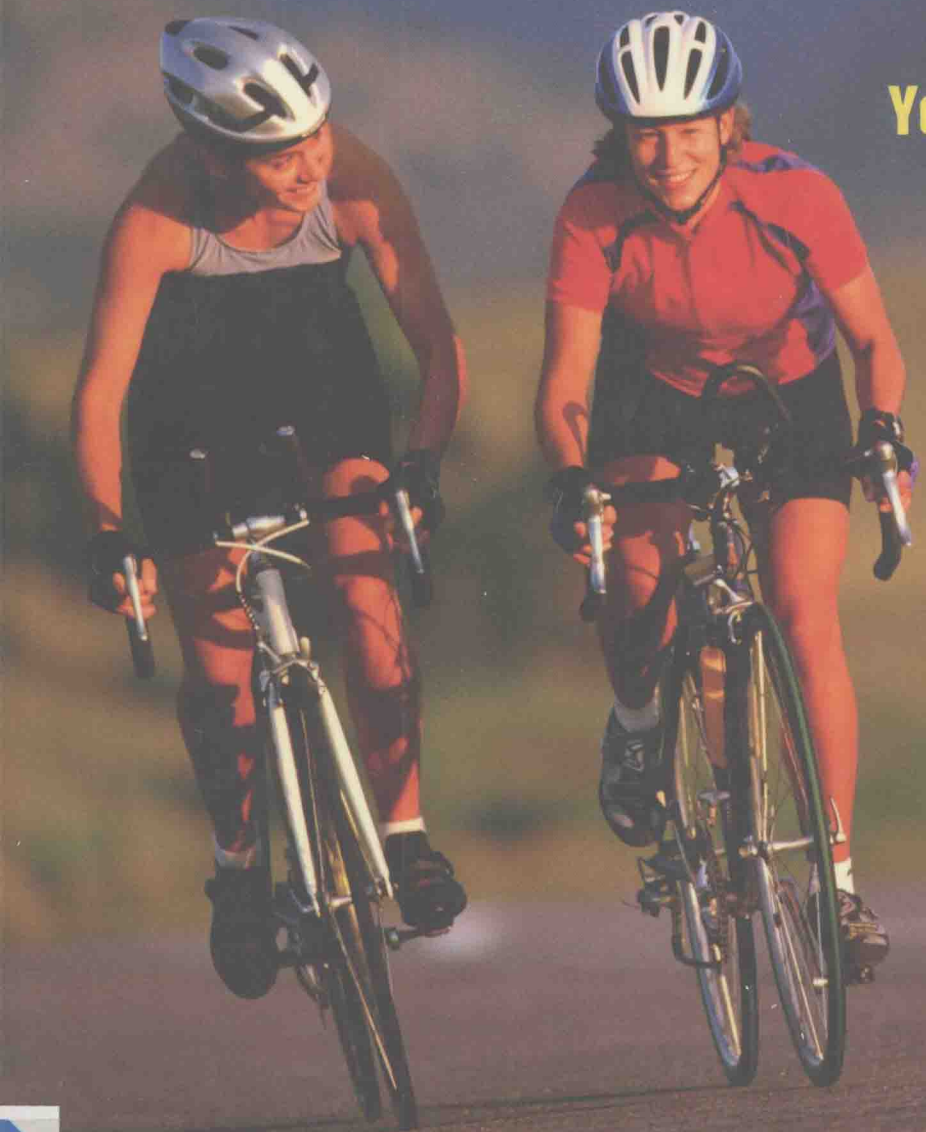
Seventh Edition

Fitness & Health



Your complete guide to

aerobic fitness
muscular fitness
nutrition
weight control

Brian J. Sharkey / Steven E. Gaskill

Fitness & Health

SEVENTH EDITION

Brian J. Sharkey, PhD
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Human Kinetics

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To Ann and Kathy, perfect companions for the active life.

Preface

In 1974, Brian Sharkey published his first book, *Physiological Fitness and Weight Control.* According to the Centers for Disease Control and Prevention (CDC), if followed, this sound advice could save thousands of lives annually! That information has been around for decades, yet the population is far less active. We now face an epidemic of overweight and obesity. All this has occurred during a period in which we have learned a great deal more about physical activity, fitness, and health. These exciting research developments led to a new book, *Physiology of Fitness* (1979), and then second and third editions in 1984 and 1990. The editions of that book chronicled new developments and the author's journey from fitness enthusiast to performance advocate and, finally, to campaigner for the benefits of the active life.

In 1997, the fourth edition was retitled *Fitness and Health*. Epidemiological studies demonstrated that people can achieve many health benefits with regular, moderate physical activity and can earn even greater rewards by improving their level of fitness. But the greatest gains for personal and public health come when people move from sedentary living to an active lifestyle. The fifth edition of the book was published in 2002.

After 30 years of solitary effort, Brian decided to seek the assistance of a friend and colleague, Steve Gaskill, for the sixth edition. They met in 1980 when Steve was a coach and Brian was sport physiologist for the U.S. Nordic ski team. In the late 1980s, their lives took separate directions, but they remained friends and kept in touch. In 1998, after completing his doctorate in exercise physiology, Steve applied for a position at the University of Montana just as Brian was preparing to retire from there. Since then, they have renewed their professional and personal association, conducting research and development activities in the Human Performance Laboratory and in the field. Steve brought new ideas and energy to the book.

This totally revised seventh edition focuses on how you can bring about changes in important health behaviors and change your life. It also revives a chapter popular in earlier editions, titled Physiology of Fitness: Muscles, Oxygen, and Energy. It presents exciting new information on physical activity and brain health and about how the active life improves learning, high-order brain processes, and academic achievement. Finally, to help readers incorporate the active life, the authors have increased the information on behavior modification and purposeful exercise. This edition includes new information, charts, and graphs, as well as a clear focus on how you can achieve the many benefits of activity and fitness.

Written for adults of all ages, this book is especially intended for the person who wants to develop a deeper understanding of fitness and health, for the enthusiast who wants to know why and how the body responds, for the newcomer who needs motivation, and for the skeptic who needs proof. The authors have always sought to write a thinking person's fitness book, and they hope you'll find that this edition meets that description. Together, they plan to make this the best and most useful source available, one that will add purpose and meaning to involvement in regular, moderate physical activity.

HOW THIS BOOK IS ORGANIZED

Part I conveys the importance of regular, moderate physical activity. It describes how active habits contribute to health, vitality, and the quality of life. The added benefits associated with improved aerobic and muscular fitness are also discussed. Part II focuses on the psychology of behavior and how you can change behavior. Part III deals with aerobic and muscular fitness and the underlying physiology. Part IV presents proven ways to achieve aerobic and muscular fitness. Part V presents new information in the areas of nutrition and weight control, information that could reverse the current epidemic of obesity. Part VI shows you how to improve your performance in sport and work and how to cope with the environment.

Each chapter includes useful information in tables and figures, and some contain testing procedures and proven fitness programs. The special inserts (shaded boxes) provide additional background and details concerning fitness and health.

INSTRUCTOR RESOURCES

Developed for instructors of *Fitness and Health, Seventh Edition*, the instructor guide, test package, and presentation package plus image bank will assist you in developing courses that inspire students. All ancillary materials are free to course adopters and can be accessed at www.HumanKinetics.com/FitnessAndHealth.

- The **instructor guide** includes sample lecture outlines, key points, and student assignments for every chapter in the text, along with sample laboratory exercises and direct links to a range of detailed sources on the Internet.
- The **test package** features a bank of questions, including true-or-false, fill-in-the-blank, essay and short-answer, and multiple-choice. The test package is available for use through multiple formats, including a learning management system, Respondus, and rich text.
- The **presentation package plus image bank** includes PowerPoint slides of text, photos, and artwork from the book that instructors can use for a class discussion and illustration. The slides in the presentation package can be used directly within PowerPoint or printed to make transparencies or handouts for distribution to students. Instructors can easily add, modify, and rearrange the order of the slides as well as search for slides based on key words.

Join us as we enter a new era of physical activity and fitness, an era in which benefits are great compared to effort expended. Enjoyment and satisfaction will replace guilt and failure. Soon, activity and fitness will be recognized and practiced as vital contributors to health and the quality of life.

Brian and Steve

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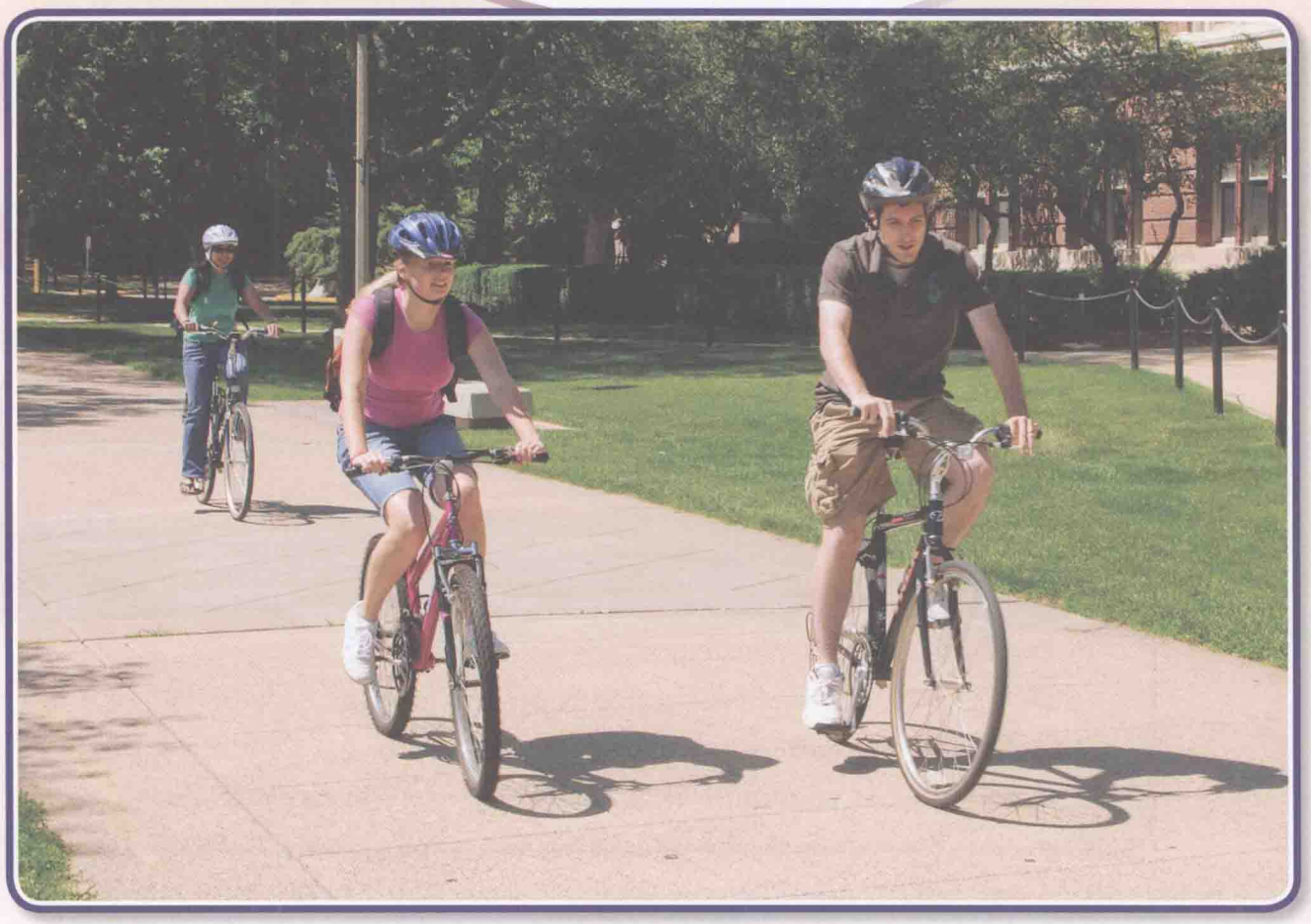
Introduction to the Active Life

> "When you come to a fork in the road . . . take it."
>
> *Yogi Berra*



You've come to a fork in the road. One path shows evidence of heavy traffic, whereas the other, the one less traveled, is faintly etched into the land. One travels downhill, the route of least resistance, while the other rises slowly to distant heights. Will you be seduced by the easy route or motivated by the high road and the view from above? Sadly, many choose the easy route. Consequently, Americans have lost their identity as a vigorous, vital people. Along the way, they have become the fattest nation in the world, beset with chronic **fatigue**, **depression**, degenerative diseases of the heart, cancer, and **diabetes**. Our goal is to convince you to take the road less traveled, the active life, knowing that it will make all the difference in your **health** and vitality.

What is the road less traveled? Simply stated, it is the active life, a way of living based on regular physical activity and a cluster of related behaviors, including healthy food choices, weight control, stress management, abstinence from tobacco and drugs, moderate use of alcohol, attention to safety (wearing seat belts and helmets), and disease prevention. It is the path of individual responsibility that leads not only to health, vigor, and vitality, but also to self-respect and control of your destiny. This family of health-related behaviors has proved to be a profound paradox for our society, simple to comprehend but difficult to adopt.

People led active lives before society achieved the benefits of industrial modernization—technological developments, the automobile, labor-saving devices, television, and computers. These marvels of ingenuity now make it possible to minimize daily **energy expenditure** by using buttons, keystrokes, and voice commands to meet survival, work, and entertainment needs. Parallel to the decline in the need for human energy expenditure has been an increase in the consumption of highly processed, calorie-rich products, such as convenience and fast foods. Calorie-rich refined sugar has replaced complex **carbohydrate**, such as corn, rice, beans, and whole-grain breads and pasta. Food chemists added hydrogen to vegetable oils (hydrogenated fat, also known as trans-fatty acids) to prolong shelf life, but the final product does not prolong human life. Low-cost palm and coconut oils have replaced other ingredients to cater to our demand for tasty food in a hurry. Restaurant and fast-food servings grew larger while physical activity declined. Individually, the decline in activity or the rise in food consumption may not have been such a problem. Coming together as they have in recent years, the potential exists for alarming growth in the epidemic of diseases caused by the way we live. Fortunately, we can change these behaviors.

This introduction will help you do the following:

- Understand the dimensions of the active life
- Determine the benefits of active living and **fitness**
- Define the amount of activity needed for health
- Compare your current level of activity with recommended values

THE ACTIVE LIFE

Our species, *Homo sapiens*, emerged in central Africa more than 50,000 years ago. Genetic information indicates that our ancestors spread across the face of the earth as hunter–gatherers. Agriculture emerged some 10,000 years ago. Throughout this migration and until

recently, by necessity, we humans have lived an active life. But that has changed, slowly at first, until the last few decades when we accelerated our transformation to sedentary ways. In 2001, less than 30 percent of the U.S. population was getting the minimum amount of exercise associated with health (150 minutes of moderate activity, such as brisk walking, per week) (Booth and Chakravarthy 2002). Only 10 years later, the U.S. Centers for Disease Control and Prevention (CDC 2011) report that barely 20 percent achieve the physical activity health guidelines and that 30 percent of American adults do no moderate physical activity at all. Very few people (about 10%) engage in sufficient activity for improving fitness and achieving additional health benefits. Few of us understand and appreciate the pleasures and benefits of the active life. The sedentary lifestyle has spread across the United States with the greatest level of inactivity in the southeast, as shown in figure I.1.

Sedentary behavior is bad for your health, leading to overweight and **obesity** for two-thirds of the adult population of the United States. The excess weight is associated with diabetes, heart disease, and some cancers, all of which are non-communicable diseases partially attributed to lifestyle. When people, even active ones, do too much sitting (in front of the TV, at the desk or computer, or driving in a car), the risk for premature mortality rises. We need to be more active and to break up sedentary time with periods of activity (Owen et al. 2010).

Sport psychologist William Morgan (2001) suggests that part of the reason people don't start or drop out of exercise programs is that the physical activity presented to the population lacks purpose and the exercise prescription focuses on measuring **heart rates** and **duration** instead of enjoyment or accomplishment.

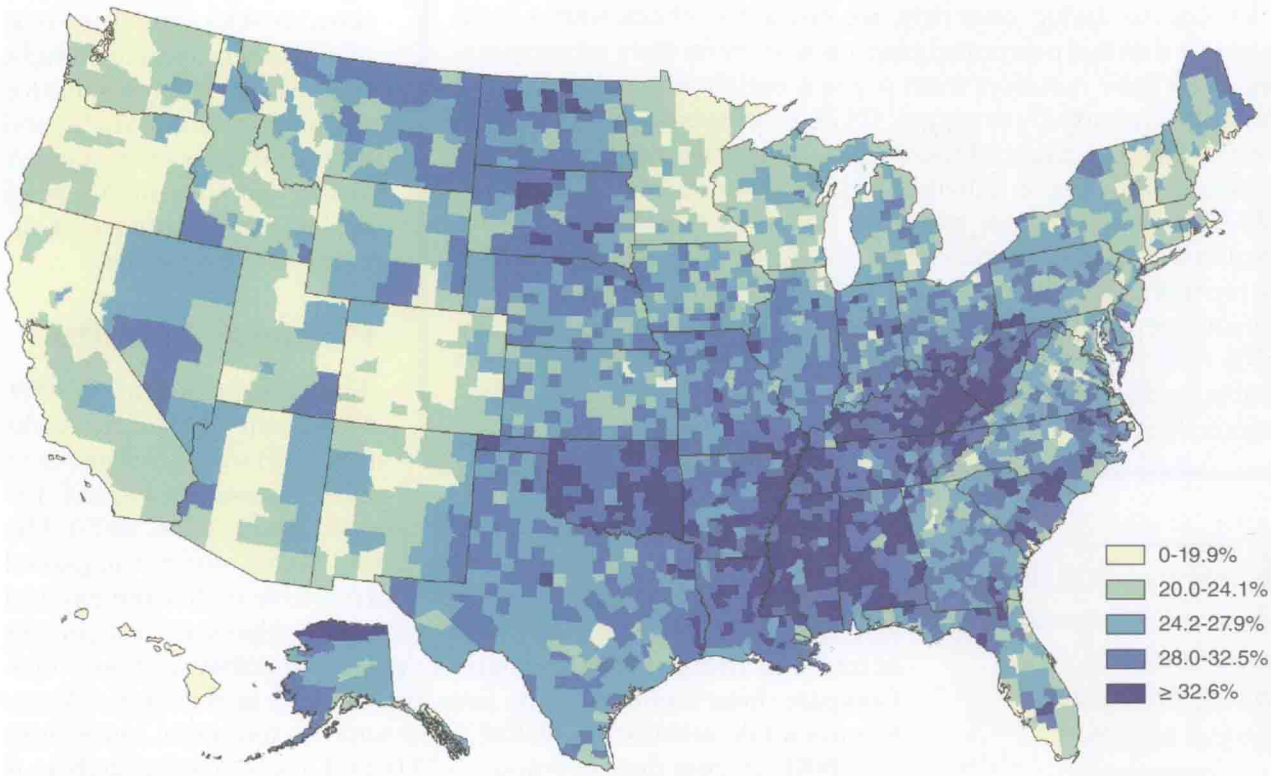


FIGURE I.1 CDC age-adjusted estimates of the percentage of adults who are physically inactive.
Reprinted from http://apps.nccd.cdc.gov/DDT_STRS2/NationalDiabetesPrevalenceEstimates.aspx?mode=PHY

Why do strong arms fatigue themselves with frivolous dumbbells? To dig a vineyard is worthier exercise for men.

Marcus Valerius Martialis (38–103 AD)

Morgan presents evidence of lifelong exercisers who engage in meaningful activity almost every day of their lives (as do your authors). Stone and Klein (2004) have found that long-term exercisers did so for fitness and health, but more importantly, for the powerful feelings generated by their regular participation (e.g., energy, enjoyment). Their activity had purpose, and yours should, too. Keep that in mind as we explore the active life.

The Cost of Physical Activity to Your Business or Community

The CDC, working with East Carolina University, provides a free, scientifically based web calculator to estimate the cost of physical activity in your community or business (www.ecu.edu/picostcalc). We (the authors of this book) decided to check on our local community of Missoula, Montana. We were staggered to learn that sedentary behavior is probably costing Missoula about $19 million in health care, $230,000 in workers' compensation, and $87 million in lost productivity. Furthermore, the calculator suggested that if we can get 5% of the inactive community members to become active, it would help the economy by about $5 million every year!

Of course, being scientists, we did a minicheck with a local business that has promoted physical activity for their employees. We used their numbers from 4 years earlier when they started their physical activity program. Of 26 employees, 19 (73%) were initially inactive. Eight of those (42% of inactive employees) participated fully in the activity program. The average salary was $29,000. The calculator suggests that sedentary lifestyles were costing the company around $50,000. After four years of the activity program, annual medical costs have dropped by $2,100 per person, per year. The business, with only 24 current employees (60% now meet physical activity health guidelines), has grown profits by $34,000 per year, well exceeding the predicted calculations. Not bad.

HEALTHY BEHAVIORS

The active life is at the core of a cluster of behaviors or habits that, viewed one at a time, seem too simplistic to be of much value. Yet collectively, they are our greatest hope for personal health and vitality and for the integrity of the nation's health care system. Many of the behaviors remind us of our mothers' admonitions.

Physical Activity

The CDC reports that in 2009, 37 percent of all U.S. deaths (897,000) were attributable to heart disease, stroke, and diabetes, all of which can be reduced with physical activity (CDC 2009). The National Alliance for Nutrition and Activity (NANA) further suggested that nearly 400,000 deaths were directly attributable to diet and physical inactivity (Wootan and Hailpern 2005). Stated another way, 18.1 percent of total U.S. deaths can be attributed to physical inactivity and poor diet. Compare those numbers to the lives lost annually in the United States in automobile accidents (~40,000), from unprotected sexual intercourse (~30,000), or from drug overdoses (~20,000). Lack of physical activity is now considered as much a contributor to heart disease as high blood cho-

As many as 300,000 lives are lost annually because of lack of regular, moderate physical activity.

lesterol, high blood pressure, and cigarette smoking, not because inactivity is more potent, but because so many of us are inactive or sedentary. Activity can reduce heart disease and control heart disease risk factors—elevated cholesterol, high blood pressure, diabetes, and obesity. Inactivity contributes to a substantial number of deaths annually. While physical activity is nearly free, the medical costs of chronic disease as a result of physical inactivity is estimated at $147 billion a year for obesity and $116 billion a year for treating diabetes in the United States (Finkelstein et al. 2008, Chenoweth 2005). Even more alarming is a report (Fincham 2011) noting that the cost of physically unfit and overweight people to American productivity and earning cost the United States more than $998 billion in 2010.

Healthy Food Choices

Poor food choices contribute directly to overweight, obesity, heart disease, diabetes, and cancer, and they contribute indirectly to other problems such as depression. After years of health education, average Americans still get 30 to 40 percent of their daily calories from **fat.** A substantial portion of their carbohydrate calories comes from highly processed **simple sugar** instead of from fruits, vegetables, and grains.

Understanding the importance of **nutrition** and food choices becomes even more important as greater numbers of Americans enter the workforce, work longer hours, and rely more on convenience foods, take-home meals, and eating out. Along with healthy food choices, the modern urban warrior needs to develop eating survival techniques. Poor diet, coupled with lack of exercise, causes at least 400,000 deaths a year, mostly from heart disease, and contributes to an increased risk of diabetes, cancer, and other ills. We'll say much more about food and nutrition in part V.

The World Is Fatter, Not Better Fed

Just because people are gaining weight does not mean the world is better fed or healthier, says the environmental group Worldwatch Institute. The institute reports that the share of adults worldwide who are overweight jumped from 1.5 billion in 2002 to nearly 2 billion in 2010, an increase of 25 percent, at the same time that the number of chronically hungry increased to well over 1 billion people. Being obese or underweight often results from the same problem—malnutrition. In the United States and other wealthy countries, the richer and the better educated people tend to eat well, whereas the poor often balloon from a diet of cheap and fatty fast foods. "Often, nations simply have traded hunger for obesity, and diseases of poverty for diseases of excess," said Worldwatch researchers. In the United States, well over 60 percent of the population is overweight; one in three adults is considered obese (Centers for Disease Control 2011c).

Weight Control

Dieting for weight loss is the most unsuccessful health intervention in all of medicine. More than 90 percent of people who have lost 25 pounds (11 kg) or more will return to their previous weight within the year. Worse yet, many weight-loss programs (diets) contribute to obesity. The truth that has emerged from the last decade of research is that diet alone won't help people achieve permanent weight loss. What will? The active life, combined with healthy food choices, and **behavior therapy** if necessary, is the answer to lifelong weight control. Activity maintains or builds the lean tissue (muscle) that has the capability to burn calories. Diet, by itself,

Dieting for weight loss is the most unsuccessful health intervention in all of medicine.

■ Activity builds lean tissue and is a lifelong solution to weight control.

leads to loss of muscle and a reduction in daily caloric expenditure, resulting in increased storage of fat.

Stress Management

Stress is our emotional response to events in life. What one person perceives as stress may be stimulating to another. Stress management implies the learning of effective coping strategies, or ways to deal with the many sources of stress in modern life. Stress has been linked to heart disease, cancer, ulcers, immunosuppression, and other ills. The link is uncertain, however, because of the difficulty in measuring stress and because some ills have been found to have other causes (e.g., ulcers are caused by bacteria). What is certain is that people can learn to cope with minor irritations and most major threats. The best results come when a person combines learned **behavior changes** with an arsenal of coping skills. Regular, moderate activity is the ideal way to cope with stress because it is effective, long lasting, much less expensive than drugs, and

Moderation Is Fun!

One of the enjoyable little moments that Brian has daily is sitting down to watch the evening news with a light beer and some low-fat pretzels. The beer provides a tasty way to relax, reduce stress, and lower the risk of heart disease. Likewise, Steve joins his wife for what she terms "booze and news" when they enjoy the evening news on TV and a small glass of red wine.

provides other health benefits. As you'll see in chapter 2, activity can be psychologically therapeutic as well as preventive.

Other Healthy Behaviors

Another important aspect of the active life includes eliminating negative behaviors, such as addiction to tobacco and other drugs, and moderating the use of alcohol. According to the Public Health Service's Office for Disease Prevention and Health Promotion, tobacco causes more than 400,000 deaths annually, including 30 percent of cancer deaths, 85 percent of all lung cancer deaths, and 21 percent of **cardiovascular** deaths. Illegal drug deaths total 20,000 per year, including overdose, suicide, homicide, AIDS (HIV infection), and more. Alcohol misuse causes 100,000 deaths a year, including almost half of all deaths from motor vehicle accidents (USDHHS and Public Health Service 1991). Yet one or two drinks of alcohol each day, whether wine, beer, or the hard stuff, are associated with reduced risk of heart disease. Who says disease prevention and health promotion have to be boring?

Safety habits such as the use of seat belts and child restraints in automobiles contribute to health and longevity. Bicycle, motorcycle, and skiing helmets reduce the severity and cost of accidents. Those who refuse to use safety devices should consider the effect on family, friends, and themselves.

The final category of health behaviors that we want to mention is the habitual practice of preventive measures appropriate to your age, sex, medical condition, and family history. These measures include vaccinations and other preventive measures such as **blood pressure** and **cholesterol** checks and tests for glaucoma and prostate, breast, and skin cancer (see chapter 3). The fact is that you, not your doctor, are responsible for your health. By combining personal responsibility with prevention and early detection tests, you have a cost-effective strategy for survival. The strategy is cost effective because prevention is always cheaper than treatment, because you use lower-cost health providers, and because you need to see physicians less frequently. If your employer has a comprehensive employee health or **wellness** program, use it. If not, create your own as you assume personal responsibility for your health.

By combining personal responsibility with prevention and early detection tests, you have a cost-effective strategy for survival.

Integration

By now, you've noticed how many facets of the active life interact in a reciprocal manner. Activity maintains muscle, which burns **calories**, helps maintain a healthy weight, and reduces the risk of heart disease, diabetes, and cancer, while also serving as the centerpiece of the stress management program. Of course, activity helps you look better, improves vitality, and reduces fatigue. Healthy food choices help you maintain or lose weight, lower cholesterol, make physical activity more enjoyable, and reduce the risk of heart disease, cancer, and other ills. The active life is not a hodgepodge of unrelated habits; it is a highly integrated family of behaviors that become more potent in combination than each is individually.

THE ROAD LESS TRAVELED

Some 30 percent of the U.S. population is completely sedentary (getting no physical activity), and another 78 percent does less than the minimum recommended activity (30 min of moderate activity most days of the week). Therefore, only 22 percent get the minimum recommended activity (CDC 2011b), and probably less than 10 percent achieve the