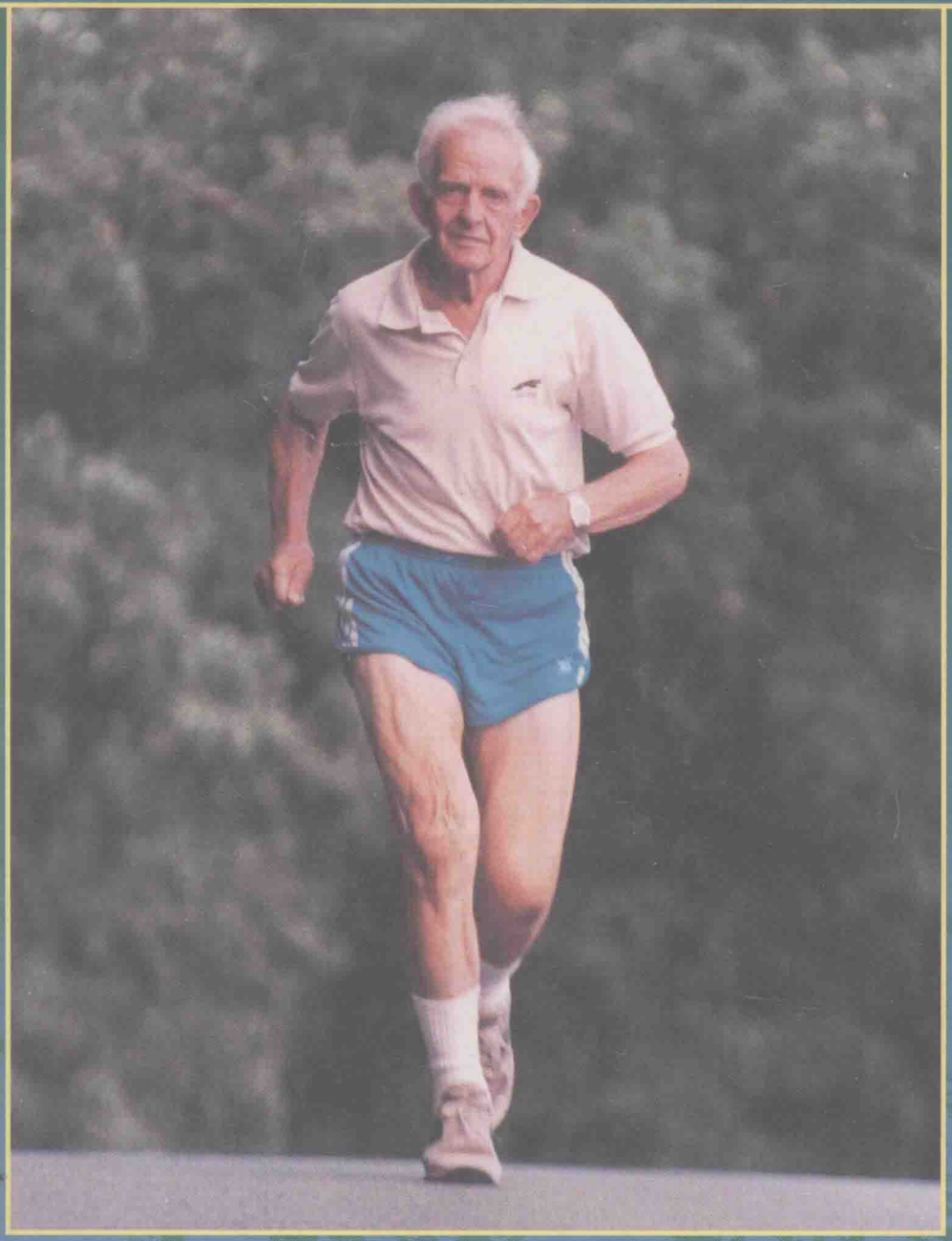
Physical Dimensions of Aging



Waneen W. Spirduso

Physical Dimensions of Aging

Waneen W. Spirduso, EdD
The University of Texas

Human Kinetics

Library of Congress Cataloging-in-Publication Data

Spirduso, Waneen Wyrick.
Physical dimensions of aging / Waneen W. Spirduso.
p. cm.
Includes bibliographical references and index.
ISBN 0-87322-323-3
1. Aging--Physiological aspects. I. Title.
QP86.S65 1995
612.6'7--dc20 94-43969
CIP

ISBN: 0-87322-323-3

Cover photo of runner Carl Llewellyn courtesy Ric Dugan/Herald-Mail Company.
Chapter 9 photo courtesy Mary Langenfeld Photo.
Chapter 14 photo of rower Sam Daniels, courtesy Craig Daniels.
Part I center, chapter 2, chapter 3, chapter 6, Part IV upper right, and chapter 10 photos © 1995 Connie Springer.
Part I lower right, chapter 1, Part II center, Part II upper left, chapter 4, chapter 5, Part III center, Part III lower right, chapter 7, chapter 8, Part IV center, chapter 11, chapter 12, chapter 13, Part V center, and Part V upper left photos © Terry Wild Studio.

Developmental Editor: Larret Galasyn-Wright; **Assistant Editors:** Julie Marx and Dawn Roselund; **Copyeditor:** Dianna Matlosz; **Proofreader:** Nedra Lambert; **Indexer:** Theresa J. Schaefer; **Typesetters:** Julie Overholt and Angela Snyder; **Layout Artist:** Denise Lowry; **Photo Editor:** Boyd LaFoon; **Text Designer:** Judy Henderson; **Cover Designer:** Jack Davis; **Illustrator:** M.R. Greenberg; **Printer:** Braun-Brumfield

Printed in the United States of America 10 9 8 7 6 5 4

Human Kinetics
Web site: http://www.humankinetics.com/

United States: Human Kinetics, P.O. Box 5076, Champaign, IL 61825-5076
1-800-747-4457
e-mail: humank@hkusa.com

Canada: Human Kinetics, 475 Devonshire Road, Unit 100, Windsor, ON N8Y 2L5
1-800-465-7301 (in Canada only)
e-mail: humank@hkcanada.com

Europe: Human Kinetics, P.O. Box IW14, Leeds LS16 6TR, United Kingdom
+44 (0)113-278 1708
e-mail: humank@hkeurope.com

Australia: Human Kinetics, 57A Price Avenue, Lower Mitcham, South Australia 5062
(08) 82771555
e-mail: humank@hkaustralia.com

New Zealand: Human Kinetics, P.O. Box 105-231, Auckland Central
09-523-3462
e-mail: humank@hknewz.com

To my mother, who has spent a lifetime being my biggest fan, but who sometimes wondered whether she would ever see this book in her lifetime; to Comel, who takes such good care of my biggest fan; and to Craig, for his love, support, and forbearance.

Foreword

Here is a book many of us have been waiting for. While the field of aging is notable for its rich collections of data, it has also suffered from a general lack of integration. But with the publication of *Physical Dimensions of Aging* by Waneen Spirduso, that is no longer the case. Not only does Dr. Spirduso thoroughly review the *facts* about physical aging, but more important, she *synthesizes* those facts into a coherent story that reveals how our bodies age.

Dr. Spirduso's years of productive research give her a unique perspective that enables her to "shake the theoretical trees" of our field. What is significant about this book is the way she pulls together so many diverse concepts, data sets, theories, and interpretations of physical aging.

Taking an organismic point of view that should be encouraged in students and researchers, Dr. Spirduso examines biological and environmental factors that influence aging and physical performance. (One of her recurring themes deals with the source of individual differences and how these differences are reflected in individual aging patterns.) She cites a range of material culled from respected journals in physiology, psychology, medicine, sports medicine, and gerontology to address basic concepts of energy, work, and efficiency and how they relate to the physical performance of fit and unfit adults of different ages.

There are few scholarly attempts to rival Dr. Spirduso's; it obviously took years for her to review and integrate the body of literature that forms the foundation of this book. I, for one, am glad she was willing to take on such a task. *Physical Dimensions of Aging* is the benchmark against which other such books will be judged. I will use it frequently, and I advise you to do the same.

James E. Birren, Director
Borun Center for Gerontological Research
UCLA School of Medicine

Preface

One of the certainties of life, perhaps the only one, is that every day everyone grows older. A time comes in each of our lives when this fact becomes personally relevant. The time is different for everyone, and the awareness may be sudden or subtle, but at some age each of us *really* understands for the first time that we are not immortal. For many people this revelation is precipitated by a physical experience—a father's unexpected loss to his son in a short race, sore muscles following softball at the company picnic, the first time you wonder if you can climb all the steps to the top of the monument on vacation. Of all human dimensions, the physical is usually the first to convince us that no one is an exception to the rule—we all are aging. Not only does the physical dimension provide us with clues to this effect, but it becomes a constraining factor in what we can do; and if we live long enough, physical aging begins to define our quality of life. Because physical function is central to most of our activities, our physical efficiency permeates all aspects of our life. Physical aging affects us cognitively, psychologically, socially, and spiritually.

This book discusses how people age physically and how this aging affects other dimensions of life. It will be of interest to anyone who is personally experiencing signs of aging, which includes almost everyone over the age of 40. Primarily, however, *Physical Dimensions of Aging* is written for undergraduate and graduate students planning to be professionals or researchers who work with adults and the elderly, in such areas as counseling psychology, gerontology, health promotion, medicine, psychiatry, nursing, pharmacy, physical fitness, physical therapy, and social work. Because the book is research based, researchers who study physical aging in these professions and in disciplines such as biomechanics, exercise physiology, and psychology will find this book to be a resource. I have integrated findings on physical aging from over a hundred different journals in myriad fields, creating interdisciplinary coverage of the topic.

Interest in gerontology has accelerated remarkably since the early 1980s, leading to growing numbers of research centers, undergraduate and graduate courses, and graduate programs on gerontological topics. I believe that every health professional who works with older adults needs to understand the nature of physical aging and the profound impact it can have. This belief is apparently shared by the developers of many gerontology programs, because a triad of core courses—covering the biology of aging, the psychology of aging, and the sociology of aging—is usually required as an introduction to the subject. Peterson (1985)*, reporting on required courses in graduate gerontology programs, found that courses addressing the biology of aging were ranked third in number, and courses that covered health

and aging were ranked seventh. Since Peterson's report, the numbers of gerontology programs and students in them have increased, as has interest in the health and physical capabilities of the elderly.

Although it is important for professionals to understand basic concepts of the biology of aging (survival curves, interspecies aging patterns, theories of aging, evolutionary aspects of aging, etc.) equally important are the age-related changes in the body's major physical systems and how these changes impact physical capacity, mobility, and performance. Professionals must also understand not only the full range of physical function but also how function can be manipulated by health habits and, perhaps more importantly, how these physical changes influence other aspects of human mental and social functioning.

The term *physical dimensions* is deliberate in the title of this book, emphasizing the multidimensional effect of physical aging on individuals from late-middle to old age. From beginning to end, I emphasize the importance of our physical being in the process of all aspects of aging and the contribution that maintenance of physical capacity and performance makes to successful aging. It is because I believe that the various physical dimensions of aging should be studied in an integrated and cohesive manner that I decided to write this book alone rather than to edit a collection of chapters from the most celebrated experts on each topic. Several fine books of that type already exist, but they provide primarily resource information on specific topics, rather than an informational base of understanding of the physical dimensions of aging and their impact on the aging individual. In this book I introduce students and professionals to the basic concepts of age-related changes in energy, work, efficiency, motor control, coordination, and skill; to the concept of functional age; and to the role that health habits and physical exercise play in modifying functional age. Because physical health and competency play an increasingly important role in determining the quality of life of aging adults, I address the interdependence of physical health, mental function, emotional control, and self-esteem at every level, from the frail elderly to exceptionally capable Senior Olympians and masters competitors.

From the moment I conceived of this book, I decided that, although based on research information, it should be primarily an introductory survey of the various dimensions of physical aging. Thus, the professionals and researchers who focus on specific areas may view the background information on their specialties to be simplistic, but they should find its applications to the aging process informative. My students, undergraduates and graduates from many different professions and disciplines, found this to be true. They discovered, to their surprise, that the information in chapters outside their areas of specialization added important information to their knowledge. For example, exercise physiologists who specialize in older adult physical performance found little new information in the chapter on aerobic work capacity. However, they did find the chapters on physical development, physical function of the frail elderly, and comparisons of elite athletes' performances to be useful in their work. Similarly, gerontological physical therapists with substantial knowledge about strength, posture, and locomotion found they also needed information on elderly work capacity, functional testing of the frail elderly, and the role of mobility in emotional function and well-being. Without exception, my students found that this integrated approach to the understanding of the physical dimensions of aging widened their perspectives of their work, gave them a greater appreciation of the impact of physical aging, and made them more effective in their professions.

The book begins with an introductory chapter on the concept of aging in terms of longevity and quality and quantity of life. Because one of the most characteristic aspects of aging is how different it is for each person, the second chapter emphasizes individual differences. The rest of the book presents information related to four major areas of human movement: energy, work, and efficiency; motor control, coordination, and learning; involvement, interdependence, and skill; and physical performance. The physical aspects of growth and form, that is changes in body composition, bone, flexibility, and skin are discussed in chapter 3. Chapters on work capacity, muscular strength, and endurance discuss the capacities of individuals in terms of energy, work, and efficiency. Effects of aging on motor control, coordination, and physical skill are organized as posture, locomotion, and simple movements (chapter 6), behavioral speed (chapter 7), and coordination and skill in complex movements (chapter 8). How the physical dimension influences our involvement in life, our dependence on others, and our achievements involves the relationship of health and physical fitness to cognition (chapter 9), emotional function (chapter 10), and our general feeling of well-being (chapter 11).

Finally, I conclude the book with a section on how aging affects older adults' physical performance in society. Physical function in the frail elderly, with all of its limitations and psychological implications, is discussed in chapter 12, and the role of physical capabilities in societal job discrimination, from airplane pilots at age 45 to white-collar workers in their 70s, is presented in chapter 13. I have saved the performance of the elite athletes for the last, chapter 14. With so much negative news about one's aging physical ability, an analysis of the great athletic performances of some of our septuagenarians and octogenarians is inspiring and uplifting. I believe that almost all professionals underestimate the physical abilities and potentials of the elderly. At a time in their lives when so many people are telling the elderly that they can't, we professionals at least should be telling them that they can.

Gerontology is a relatively new field, incredibly complex and multidisciplinary. In the study of human gerontology, physical, psychological, social, and environmental systems interact so that it is extremely difficult to identify causal relationships. Thus, each chapter has several controversial issues. I have presented these as fairly as I can, but no one person can be an expert in every field. I am, therefore, indebted to a number of people who have helped me find information, critiqued my writing, and helped me think through the ideas and concepts that I present. For their time, energy, creativeness, and encouragement, I also am grateful to many colleagues: Larry Abraham, Ann Scarborough, Ed Coyle, Russell Ewan, Roger Farrar, Jan Hutchinson, Sid Liebes, Priscilla MacRae, Bob Malina, David Reuben, and Joe Starnes. Several graduate students also read the manuscript and provided excellent suggestions: Gary Etgen, Tina Geithner, and Steve Seiler. Susan Jay improved the form and substance of the manuscript with meticulous editing and extensive research. A special note of gratitude goes to Wojtek Chodzko-Zajko and Max Vercruyssen, both of whom read the manuscript from cover to cover, made many suggestions, found many mistakes, and supplied additional information, articles, and references. Their comments have had a significant impact on the book and have improved its quality immeasurably. I also am indebted to the creativeness and ingenuity of Rosalind Lee and Kelly McQueary, who provided me with special technical assistance and skills throughout the writing of the book.

Finally, I view this book as a beginning. I hope that it will evolve over the years, through my own growth and understanding and through my interaction with others, and become a book that will be truly useful to a great many people. I therefore encourage readers to send me their comments, suggestions, and critiques.

Department of Kinesiology
The University of Texas
Austin, TX 78712
Fax: 512/471-0946
spirduso@mail.utexas.edu

---

*Peterson, D.A. (1985). Employment experience of gerontology master's degree graduates. *The Gerontologist*, **25**, 514-519.

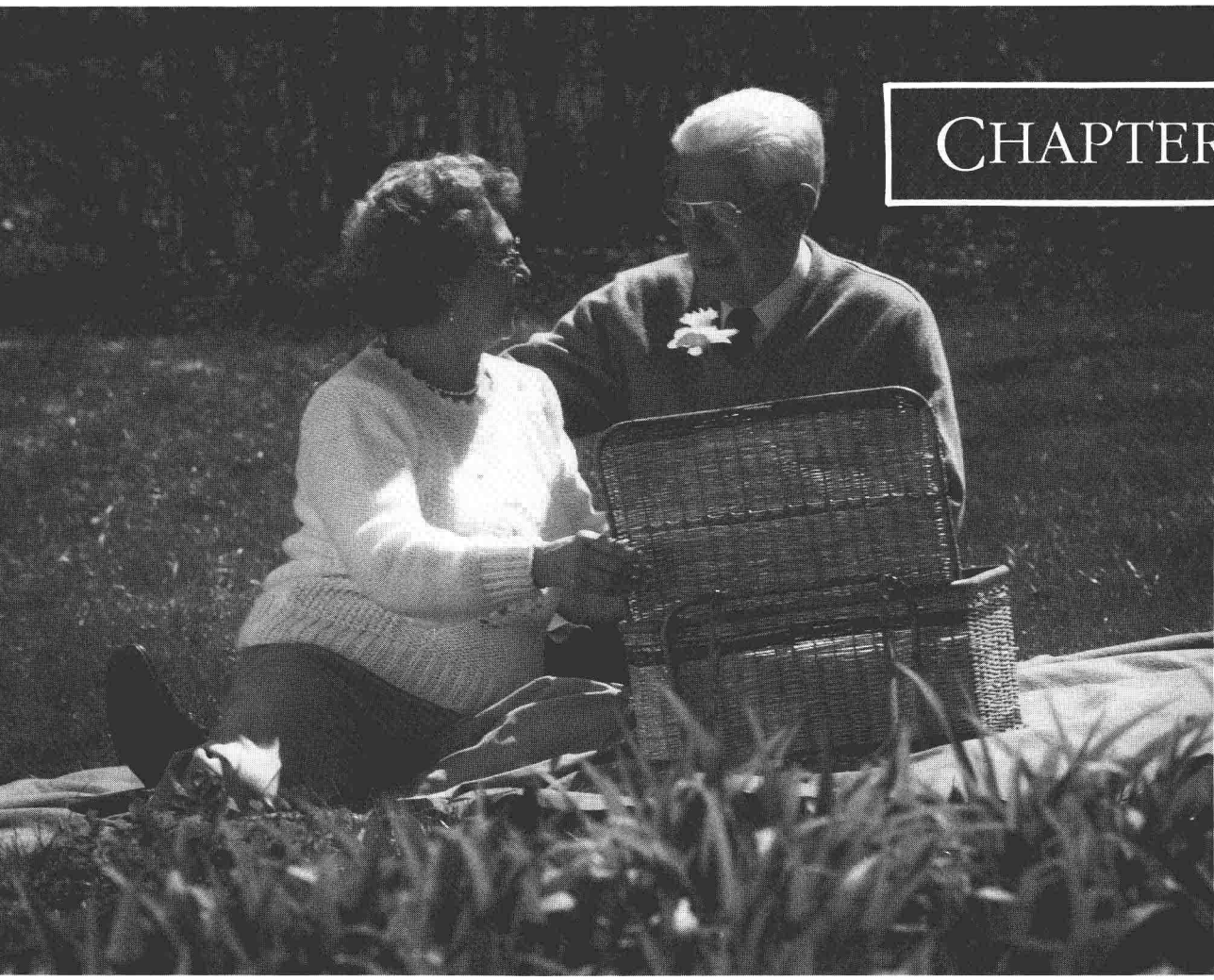
Contents

PART I

An Introduction to Aging

The first truth about aging is that everybody does it. The second truth is that everybody does it differently.

It is impossible to talk about the effects of physical aging without considering first the human life span, the notion of time, and how differently each individual moves through his or her life. Why do some people live longer than others? Why do some seem to age quickly, whereas others seem to resist aging? If living longer means living in sickness and morbidity, is it ethical for scientists to continue to search for ways to extend the human life span? What is normal aging? Is it different from sickness and disease? This section introduces the basic concepts of the biology of aging, the theories of aging, and the compression of morbidity. This section also introduces one of the most important concepts of aging: Individuals differ in the way they age and the way they react to aging. Indeed, one of the factors that makes the study of aging so difficult is that a "typical" older adult does not exist. Finally, the last chapter in this section discusses the major developmental changes that occur with aging: changes in body size and form, in muscle, fat, and bone composition, in joint flexibility, and in the skin.



CHAPTER 1

Issues of Quantity and Quality of Life

Aging is one of the great enigmas of life. Apart from birth and death, it is perhaps the only experience that every human being shares. As ubiquitous as aging is, no one fully understands it. Many throughout human history have pondered the same questions about aging: What is aging? What is its nature? Why do living organisms age? Can aging be stopped or slowed down?

Although all people age, they do so in different ways and at different rates. Some people live longer and have a higher quality of life than others. The basis of gerontology is the study of these differences, their causes, and the factors that amplify or attenuate them. The length of time, or quantity of

life, that people live is easily measured. Statistical survival curves have been developed to describe the life spans of many species, and from these, predictions can be made about the quantity of life and the rate of aging. But scholars and scientists want more. They want to understand the fundamental processes and causes of aging so that the quantity of life for humans can be maximized. The results of their studies of basic mechanisms have provided the basis for several theories of aging.

Understanding the fundamental processes of aging is not only essential to determining what causes aging, but it is also necessary if interventions are to be developed to interfere with, postpone, or stop the aging process. The goal of applied health and social scientists is to change the shape of the human survival curve so that most individuals can live long lives, and several controllable factors, such as food restriction and nutrition, general activity level, and physical activity have some promise in fulfilling that goal. Most people would agree that long life without health and physical mobility is undesirable, yet many people live their terminal years in a state of morbidity, or complete physical dependence and poor health. A substantial thrust in recent research has thus been to determine whether the occurrence and duration of morbidity in the population can be compressed. Discussions of extending the life span are always entangled with issues of the quality of life.

This chapter introduces some of the fundamental questions and basic terminology of gerontology. What is aging? How is it described? What causes it? Can the aging process be slowed? And how is the quantity of life related to the quality of life?

What Is Aging?

On the simplest level, physical age seems easy to define. It is the chronological time something has existed, or the number of elapsed standard time units between birth and a date of observation. On this level, age and time are synonymous. On another level, however, the physical dimension and meaning of time depend totally on the biological, psychological, and social significance attached to it; for that reason the concept of time has been the subject of philosophical debate for centuries. Because time and chronological aging can be viewed as synonymous, it is impossible to divorce aging from the passage of time. Yet biological processes that occur in youth are thought of as developmental, whereas time-related changes that lead to disability and dysfunction are thought of as adult aging, or senescence. When does this change in definition occur? Does aging begin in all body cells simultaneously or in different systems at different times? When does aging start? As complex as these issues are, rational discussion requires some agreement on definitions among professionals.

I use the term *aging* to refer to a process or group of processes occurring in living organisms that with the passage of time lead to a loss of adaptability, functional impairment, and eventually death. These processes are distinct from daily or seasonal biological rhythms and any other temporary change. It is particularly important to distinguish aging effects from *secular effects*, which are environmental effects that influence all people who live within an identified period. For example, during the late 1970s and early 1980s serum cholesterol levels dropped over 7-year intervals in all age groups studied in the Baltimore Longitudinal Study of Aging (BLSA). The dietary cholesterol and fiber of these subjects also changed. Attributing the drop in cholesterol to aging would be an inaccurate conclusion. Much more probable is that many of the BLSA subjects, as well as countless numbers of nonsubjects, changed their diets as a result of heavy media advertising regarding the benefits of low-fat and high-fiber diets.

Aging is a logical extension of the physiological processes of growth and development, beginning with birth and ending with death. The emphasis of this text is on the later portion of this continuum of life span growth and development.

Aging occurs with the relentless march of time, but relatively few people actually die of old age. Most die because the body loses the capacity to withstand physical or environmental stressors. Through youth, bodies have reserve physiological capacities and system redundancies that enable them to adapt to physical challenges or insults, such as exposure to viruses or to extreme heat and cold. Accompanying aging, however, is a loss in reserve capacity and redundancy, which reduces the ability to adapt quickly and effectively. For example, a young adult might be able to dodge an oncoming automobile on a hot summer day and avoid being struck. An older person, however, who has suffered cumulative losses in peripheral