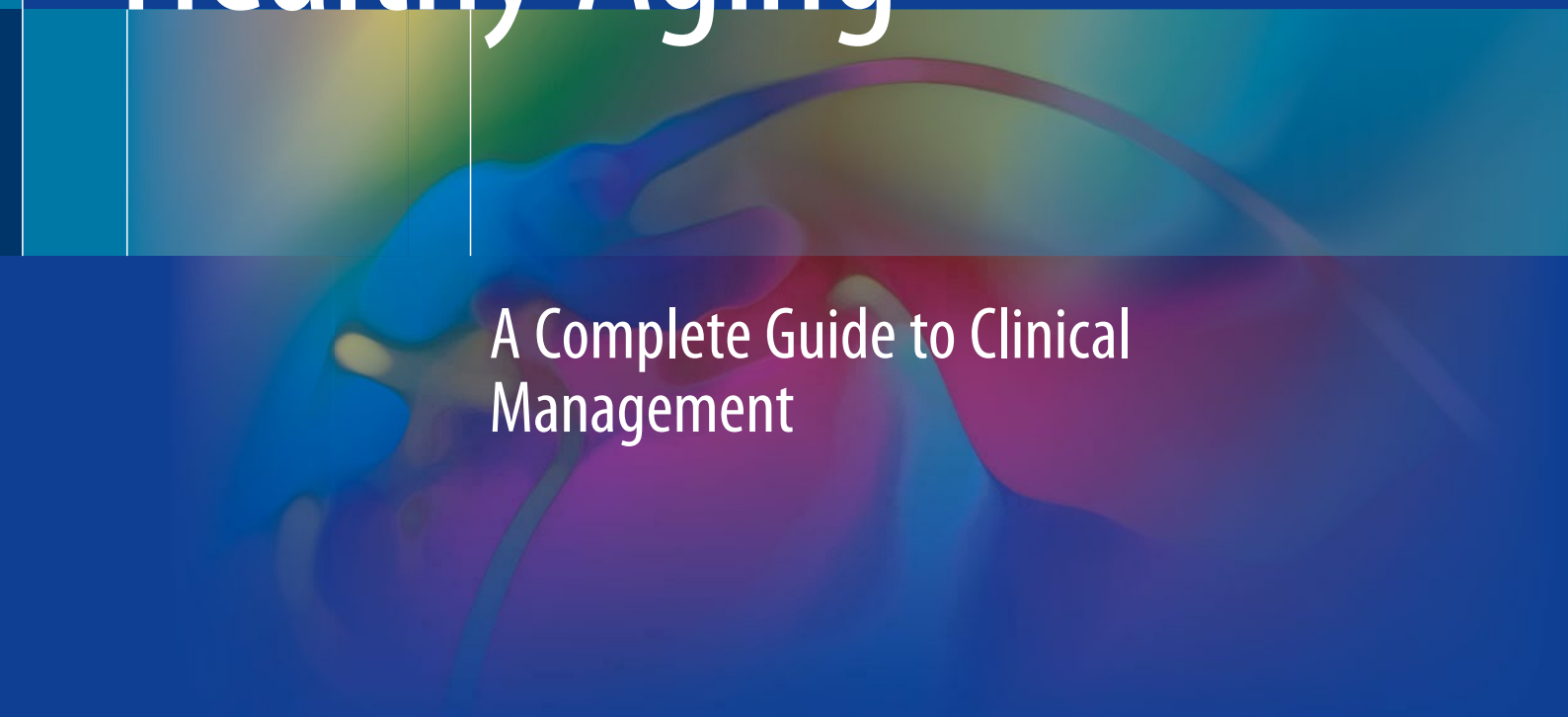
Patrick P. Coll
Editor

Healthy Aging

A Complete Guide to Clinical Management



Springer

Patrick P. Coll
Editor

Healthy Aging

A Complete Guide to Clinical Management

Springer

Editor
Patrick P. Coll
Center on Aging and Departments of Family
Medicine and Medicine
University of Connecticut School of Medicine
Farmington, CT
USA

ISBN 978-3-030-06199-9 ISBN 978-3-030-06200-2 (eBook)
https://doi.org/10.1007/978-3-030-06200-2

Library of Congress Control Number: 2018965744

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

As a physician who provides care for older patients, I know healthy aging when I see it. Some of my older patients who are healthy have been lucky with regard to their health. They have been fortunate to avoid developing diseases that they had little or no way of preventing; diseases such as rheumatoid arthritis, pancreatic cancer, or multiple sclerosis. Genetic disorders with a Mendelian transmission such as Huntington's disease provide the clearest example of luck or chance in the development of a disease. If someone has a parent who has Huntington's disease, he or she has a 50/50 chance of getting the disease; it is like tossing a coin. As we learn more about the role of genetics and disease risk, the greater the impact we will have on preventing these "bad luck" disease. However, most healthy older patients are not old and healthy because of good luck. They are old and healthy because of good choices. This book is about those good choices.

None of my current patients smoke cigarettes. Many of my patients smoked cigarettes when they were younger, but stopped smoking when the health risks associated with smoking tobacco were publicized. Many specifically tell me they stopped when the United States Surgeon General's warning on the health risks of smoking tobacco was announced. Others say they stopped when they suffered a smoking-related illness, such as a myocardial infarction. Those that did not stop smoking did not survive long enough to make it into my practice. Longevity is about making good choices. This book is about those good choices.

My healthy older patients have not only survived, they have thrived. Here too, good choices have made the difference – good choices regarding exercise, nutrition, outlook on life, immunizations, work, close relationships, and screening tests. This book is about those good choices. To make good choices you need good information, guidance, and determination. To make good choices you need financial security, good healthcare coverage, and public policies that support and encourage good choices. You need healthcare providers who are competent not only in treating disease and illness, but also in helping patients achieve good health when they are older by helping them make good choices when they are younger. This book is about those good choices.

Most of my older patients place a higher priority on the quality of their life that they do on the quantity. Most of them equate quality of life with independence and avoiding the need for assistance with tasks which they have done for themselves for a lifetime: the ability to travel without assistance, drive safely, go up and down stairs, go for a walk, get out of bed, get up from a seated position without help, go to the bathroom without needing someone's assistance, eat a regular diet, and eat without assistance. Patients who achieve lifelong independence do so because of good choices. This book is about those good choices.

Healthy aging is important from personal, family, and societal perspectives. Healthy aging is important now and will be increasingly important in the future. It is something most of us can achieve if we are lucky and more importantly, if we make good choices. This book is about those good choices.

Acknowledgments

First and foremost, I would like to thank the excellent staff at Springer Nature for their assistance with the publication of this book. I would specifically like to thank Nadina Persaud, Dhanapal Palanisamy, and Keerthana Gnanasekeran.

I would like to thank the University of Connecticut and UConn Health for supporting the time it took me to undertake the numerous tasks associated with developing and editing this book.

I would like to thank all of the authors. I am so grateful that they were willing to take the time to contribute their excellent work.

I would like to thank the American Geriatrics Society for its commitment to improving medical care for all older adults and for its efforts to promote healthy aging.

I would like to thank my wife Bonny for her support and encouragement during the time it took to develop and edit this book. I would also like to thank my children, Gabriel, Aidan, Emma, and Grace for their support.

Finally, I would like to thank my patients for their inspiration. I never cease to be amazed by the power of the human sprit and the enduring optimism, dignity, resilience, and love exhibited by my older patients. Old age may come with challenges, but there is a lot of good and beauty that comes with living a long life. It is my hope that the adoption of the principles, advice, and guidance provided by this book will allow more people to live long, independent, fulfilling, secure, and happy lives.

Contents

1 **Healthy Aging: Definition and Scope** 1
Patrick P. Coll

2 **Disease, Disability, and Frailty with Increasing Age** 9
Krupa Shah

3 **The Principles of Disease and Disability Prevention and Health Promotion with Increasing Age** 15
Neema Sharda, Kathryn Daniel, and Heidi White

4 **The Interface Between Healthy Aging, Longevity, Disease, and Disability** 23
Susan M. Friedman

5 **Cardiovascular Health and Healthy Aging** 31
Ian Reynolds, Robert L. Page II, and Rebecca S. Boxer

6 **Musculoskeletal Health and Healthy Ageing** 53
Sharon L. Brennan-Olsen, Alan Hayes, and Gustavo Duque

7 **Gastrointestinal Health and Healthy Aging** 67
Pradeep K. Siddappa and John W. Birk

8 **Pulmonary Health and Healthy Aging** 81
Brian J. Clark, Nicole Roeder, and Kathleen M. Akgün

9 **Urogenital Health: Optimizing Healthy Aging** 93
Brooke A. Harnisch, Mary Soyster, and Phillip P. Smith

10 **Skin Health and Healthy Aging: Skin Cosmetics** 105
Sonal A. Parikh, Andrew Kelsey, Justin Finch, and Jane M. Grant-Kels

11 **Skin Health and Healthy Aging: Skin Disease** 115
Andrew Kelsey, Sonal A. Parikh, Justin Finch, and Jane M. Grant-Kels

12 **Preventing Falls and Injuries and Healthy Ageing** 133
Manuel Montero-Odasso

13 **Sensory Health and Healthy Aging: Hearing and Smell** 145
Denis Lafreniere and Kourosh Parham

14 **Sensory Health and Healthy Aging: Vision** 159
Muhammad Musab Shamim, Nhon Thanh Le, Claudia Prospero Ponce, Aroucha Vickers, and Andrew G. Lee

15 **Cognition and Health Ageing** 169
Robert Briggs, Sean P. Kennelly, and Desmond O'Neill

16 **Preventing Infections and Healthy Aging** 181
Janet E. McElhaney, Melissa K. Andrew, Shelly McNeil, and George A. Kuchel

17 Cancer Prevention and Healthy Aging 189
Elise D. Cook and Lonzetta L. Newman

18 Endocrine Health and Healthy Aging 201
Faryal S. Mirza, Pamela Taxel, and Pooja Luthra

19 Oral Health and Healthy Aging 213
Sarah J. Dirks and Michael Monopoli

20 Healthy Aging and Exercise: Preventing Disease and Disability 227
Yin Wu, Gregory A. Panza, Beth A. Taylor, and Linda S. Pescatello

21 Healthy Aging and Exercise: Treating Disease and Disability 241
Yin Wu, Gregory A. Panza, Beth A. Taylor, and Linda S. Pescatello

22 Nutrition and Healthy Aging 263
Amy C. Ellis

23 Sleep and Healthy Aging 275
Eric Trieu and Cathy Alessi

24 Promoting Healthy Aging Through Recognition and Treatment of Psychiatric Disorders in Older Adults 283
Raisa Yagudayeva, Leopoldine Matialeu, Alexander J. Schupper, Keenan M. Onodera, and Daniel D. Sewell

25 Sexuality, Intimacy, and Healthy Aging 295
Els Messelis, Meredith Wallace Kazer, and Jillian A. Gelmetti

26 Pain and Healthy Aging 305
Fabio Guerriero and M. Carrington Reid

27 Creativity and Healthy Ageing 313
Desmond O'Neill

28 Human Relationships and Healthy Aging 319
Jacquelyn J. Benson, Steffany Sloan, and Allison K. Halt

29 Resilience, Adapting to Change, and Healthy Aging 329
Peter Martin, Jeongeun Lee, and Megan Gilligan

30 Mindfulness, Spirituality, and Healthy Aging 335
Brandon Nappi

31 Cultural and Socioeconomic Determinants of Healthy Aging 341
Sharon L. Brennan-Olsen, Shae Quirk, Sarah M. Hosking, Natalie K. Hyde, Rachel Duckham, and Lynne Millar

32 Employment and the Workplace Supporting Healthy Aging 349
Joanne Crawford

33 Housing and Planning Supporting Healthy Aging 355
Jennifer Molinsky, Christopher Herbert, and Ann Forsyth

34 Healthcare Systems and Healthcare Funding Supporting Healthy Aging 367
Paul Mulhausen

35 Public Policy Supporting Healthy Aging 377
Patrick P. Coll and Richard H. Fortinsky

Index 385

Contributors

Kathleen M. Akgün, MD, MS Veterans Administration (VA) Connecticut Health Care System, Section of Pulmonary, Critical Care, and Sleep Medicine, West Haven, CT, USA

Yale University School of Medicine, Section of Pulmonary, Critical Care, and Sleep Medicine, Department of Internal Medicine, New Haven, CT, USA

Cathy Alessi, MD Geriatric Research, Education and Clinical Center (GRECC), VA Greater Los Angeles Healthcare System and the David Geffen School of Medicine at the University of California, Los Angeles, Los Angeles, CA, USA

Melissa K. Andrew, MD, PhD, MSc(PH) Canadian Center for Vaccinology, IWK Health Centre and Nova Scotia Health Authority, Dalhousie University, Halifax, NS, Canada

Jacquelyn J. Benson, PhD Human Development and Family Science, University of Missouri, Columbia, MO, USA

John W. Birk, MD Division of Gastroenterology and Hepatology, University of Connecticut School of Medicine, Farmington, CT, USA

Rebecca S. Boxer, MD, MS Geriatric Medicine, University of Colorado Anschutz Medical Campus, Aurora, CO, USA

Sharon L. Brennan-Olsen, BA(Hons), GCALL, PhD Department of Medicine-Western Health, The University of Melbourne, St Albans, VIC, Australia

Australian Institute for Musculoskeletal Science (AIMSS), The University of Melbourne and Western Health, St Albans, VIC, Australia

Robert Briggs, MB, BCh, BAO Centre for Ageing, Neurosciences and the Humanities, Tallaght University Hospital, Dublin, Ireland

Brian J. Clark, MD Yale University School of Medicine, Section of Pulmonary, Critical Care, and Sleep Medicine, Department of Internal Medicine, New Haven, CT, USA

Veterans Administration (VA) Connecticut Health Care System, Section of Pulmonary, Critical Care, and Sleep Medicine, West Haven, CT, USA

Patrick P. Coll, MD, AGSF, CMD Center on Aging and Departments of Family Medicine and Medicine, University of Connecticut School of Medicine, Farmington, CT, USA

Elise D. Cook, MD, MS Department of Clinical Cancer Prevention, University of Texas MD Anderson Cancer Center, Houston, TX, USA

Joanne Crawford, PhD, MSc, BSc, C.ErgHF Institute of Occupational Medicine, Edinburgh, UK

Kathryn Daniel, PhD, RN, ANP-BC, GNP-BC, AGSF College of Nursing and Health Innovation, University of Texas at Arlington, Arlington, TX, USA

Sarah J. Dirks, DDS Department of Periodontics, University of Texas Health Science Center, San Antonio, TX, USA

Rachel Duckham, PhD Australian Institute for Musculoskeletal Science (AIMSS), The University of Melbourne and Western Health, St Albans, VIC, Australia

Deakin University, Institute for Physical Activity and Nutrition Sciences, Geelong, VIC, Australia

Gustavo Duque, MD, PhD, FRACP, GSAF Department of Medicine-Western Health, The University of Melbourne, St Albans, VIC, Australia

Australian Institute for Musculoskeletal Science (AIMSS), The University of Melbourne and Western Health, St Albans, VIC, Australia

Amy C. Ellis, PhD, RDN, LD Department of Human Nutrition and Hospitality Managment, University of Alabama, Tuscaloosa, AL, USA

Justin Finch, MD Department of Dermatology, University of Connecticut School of Medicine, Farmington, CT, USA

Ann Forsyth, PhD Department of Urban Planning and Design, Harvard University, Cambridge, MA, USA

Richard H. Fortinsky, PhD Center on Aging and Department of Medicine, University of Connecticut School of Medicine, Farmington, CT, USA

Susan M. Friedman, MD, MPH Department of Medicine, Division of Geriatrics and Aging, University of Rochester School of Medicine & Dentistry, Rochester, NY, USA

Jillian A. Gelmetti, BSN Egan School of Nursing and Health Studies, Fairfield University, Fairfield, CT, USA

Megan Gilligan, PhD Department of Human Development & Family Studies, Iowa State University, Ames, IA, USA

Jane M. Grant-Kels, MD Department of Dermatology, University of Connecticut School of Medicine, Farmington, CT, USA

Fabio Guerriero, MD, PhD Department of Internal Medicine and Medical Therapy, University of Pavia, Pavia, Italy

Allison K. Halt, MS Human Development and Family Science, University of Missouri, Columbia, MO, USA

Brooke A. Harnisch, MD Department of Surgery, Division of Urology, University of Connecticut School of Medicine, Farmington, CT, USA

Alan Hayes, BSc(Hons), PhD Department of Medicine-Western Health, The University of Melbourne, St Albans, VIC, Australia

Australian Institute for Musculoskeletal Science (AIMSS), The University of Melbourne and Western Health, St Albans, VIC, Australia

Institute for Health and Sport, Victoria University, Footscray, VIC, Australia

Christopher Herbert, PhD Joint Center for Housing Studies, Harvard University, Cambridge, MA, USA

Sarah M. Hosking, BHealthSci(Hons), PhD Monash University, Centre for Medicine Use and Safety, Melbourne, VIC, Australia

Natalie K. Hyde, BBiomedSc(Hons), PhD School of Medicine, Faculty of Health, Deakin University, Geelong, VIC, Australia

Meredith Wallace Kazer, PhD, APRN-BC, FAAN Egan School of Nursing & Health Studies, Fairfield University, Fairfield, CT, USA

Andrew Kelsey, MD Department of Dermatology, University of Connecticut School of Medicine, Farmington, CT, USA

Sean P. Kennelly, MB, PhD, FRCP(Lond), FRCPI Centre for Ageing, Neurosciences and the Humanities, Age-related Health Care,Tallaght University Hospital, Dublin, Ireland

George A. Kuchel, MD, FRCP, AGSF Center on Aging, University of Connecticut School of Medicine, Farmington, CT, USA

Denis Lafreniere, MD, FACS Department of Surgery, Division of Otolaryngology-Head and Neck Surgery, University of Connecticut School of Medicine, Farmington, CT, USA

Andrew G. Lee, MD Blanton Eye Institute, Houston Methodist Hospital, Houston, TX, USA

Baylor College of Medicine, Houston, TX, USA

Weill Cornell Medicine, New York, NY, USA

University of Texas MD Anderson Cancer Center, Houston, TX, USA

Texas A and M College of Medicine, College Station, TX, USA

Jeongeun Lee, PhD Department of Human Development & Family Studies, Iowa State University, Ames, IA, USA

Nhon Thanh Le Baylor College of Medicine, School of Medicine, Houston, TX, USA

Pooja Luthra, MD, FACE Division of Endocrinology and Metabolism, Department of Medicine, University of Connecticut School of Medicine, Farmington, CT, USA

Peter Martin, PhD Department of Human Development & Family Studies, Iowa State University, Ames, IA, USA

Leopoldine Matialeu, MD School of Medicine, University of California, San Diego, San Diego, CA, USA

Janet E. McElhaney, MD Health Sciences North Research Institute, Sudbury, ON, Canada

Northern Ontario School of Medicine, Sudbury, ON, Canada

Shelly McNeil, MD Canadian Center for Vaccinology, IWK Health Centre and Nova Scotia Health Authority, Dalhousie University, Halifax, NS, Canada

Els Messelis, MA University College Odisee, Brussels, Belgium

Lynne Millar, BA(Hons), PhD Australian Institute for Musculoskeletal Science (AIMSS), The University of Melbourne and Western Health, St Albans, VIC, Australia

Australian Health Policy Collaboration, Melbourne, VIC, Australia

Faryal S. Mirza, MD, FACE Division of Endocrinology and Metabolism, Department of Medicine, University of Connecticut School of Medicine, Farmington, CT, USA

Jennifer Molinsky, PhD Joint Center for Housing Studies, Harvard University, Cambridge, MA, USA

Michael Monopoli, DMD, MPH, MS DentaQuest Foundation, Boston, MA, USA

Paul Mulhausen, MD, MHS, FACP, AGSF Telligen Inc, West Des Moines, IA, USA

Brandon Nappi, D Min, M Div Copper Beech Institute, West Hartford, CT, USA

Lonzetta L. Newman, MD, FACP Department of Clinical Cancer Prevention, University of Texas MD Anderson Cancer Center, Houston, TX, USA

Desmond O'Neill, MA, MD, FRCPI Centre for Ageing, Neuroscience and the Humanities, Trinity Centre for Health Sciences, Trinity College Dublin & Tallaght University Hospital, Dublin, Ireland

Manuel Montero-Odasso, MD, PhD, AGSF, FGSA, FRCPC Department of Medicine, Division of Geriatric Medicine, and Department of Epidemiology and Biostatistics, University of Western Ontario, London, ON, Canada

Lawson Health Research Institute, London, ON, Canada

Gait and Brain Lab, Parkwood Institute, London, ON, Canada

Keenan M. Onodera, BA School of Medicine, University of California, San Diego, San Diego, CA, USA

Robert L. Page II, PharmD, MSPH, BCPS, BCGP, FCCP, FASHP Department of Clinical Pharmacy, Division of Cardiology, University of Colorado Anschutz Medical Campus, Aurora, CO, USA

Gregory A. Panza, MS Department of Kinesiology, College of Agriculture, Health and Natural Resources, University of Connecticut, Storrs, CT, USA

Kourosh Parham, MD, PhD, FACS Department of Surgery, Division of Otolaryngology-Head and Neck Surgery, University of Connecticut School of Medicine, Farmington, CT, USA

Sonal A. Parikh, MD Department of Dermatology, University of Connecticut School of Medicine, Farmington, CT, USA

Linda S. Pescatello, PhD, FACSM, FAHA Department of Kinesiology, College of Agriculture, Health and Natural Resources, University of Connecticut, Storrs, CT, USA

Claudia Prospero Ponce, MD Blanton Eye Institute, Houston Methodist Hospital, Department of Ophthalmology, Houston, TX, USA

Shae Quirk, PhD Monash Institute of Cognitive and Clinical Neurosciences, School of Psychological Sciences, Monash University, Clayton, VIC, Australia

Orygen, The National Centre of Excellence in Youth Mental Health, Parkville, VIC, Australia

M. Carrington Reid, MD, PhD Department of Medicine, Weill Cornell Medicine, New York, NY, USA

Ian Reynolds, MD Geriatric Medicine, Rocky Mountain Regional VA Medical Center, Aurora, CO, USA

Nicole Roeder, MD Yale University School of Medicine, Section of Pulmonary, Critical Care, and Sleep Medicine, Department of Internal Medicine, New Haven, CT, USA

HealthEast Pulmonary & Critical Care, St. Paul, MN, USA

Alexander J. Schupper, BA School of Medicine, University of California, San Diego, San Diego, CA, USA

Daniel D. Sewell, MD School of Medicine, University of California, San Diego, San Diego, CA, USA

Krupa Shah, MD Division of Geriatrics and Aging, Department of Medicine, University of Rochester School of Medicine, Rochester, NY, USA

Muhammad Musab Shamim Baylor College of Medicine, School of Medicine, Houston, TX, USA

Neema Sharda, MD Geriatrics Division, Duke University School of Medicine, Durham, NC, USA

Pradeep K. Siddappa, MBBS, MD, DM University of Connecticut School of Medicine, Farmington, CT, USA

Steffany Sloan, MEd Human Development and Family Science, University of Missouri, Columbia, MO, USA

Phillip P. Smith, MD, FPMRS Department of Surgery, Division of Urology, University of Connecticut School of Medicine, Farmington, CT, USA

Center on Aging, University of Connecticut School of Medicine, Farmington, CT, USA

Mary Soyster, BA University of Connecticut School of Medicine, Farmington, CT, USA

Pamela Taxel, MD Division of Endocrinology and Metabolism, Department of Medicine, University of Connecticut School of Medicine, Farmington, CT, USA

Beth A. Taylor, PhD, FACSM Department of Kinesiology, College of Agriculture and Natural Resources, University of Connecticut, Storrs, CT, USA

Eric Trieu, MD Multicampus Program in Geriatric Medicine and Gerontology, VA Greater Los Angeles Healthcare System and the David Geffen School of Medicine at the University of California, Los Angeles, Los Angeles, CA, USA

Aroucha Vickers, DO Las Vegas Neurology Center, Department of Neurology & Neuro-Ophthalmology, Las Vegas, NV, USA

Heidi White, MD, MHS, MEd Geriatrics Division, Duke University School of Medicine, Durham, NC, USA

Yin Wu, PhD Department of Kinesiology, College of Agriculture, Health and Natural Resources, University of Connecticut, Storrs, CT, USA

Raisa Yagudayeva, DO School of Medicine, University of California, San Diego, San Diego, CA, USA

Healthy Aging: Definition and Scope

1

Patrick P. Coll

Age

Chronological age is easy to measure using a variety of well-established measurements of time including hours, days, and years. The age of most complex living organisms, including humans, is measured in years. Living organisms are created through biologic reproduction. Following germination and birth, living organisms grow and mature. These are time-dependent changes, which are species specific, and within each species, they occur on a predetermined schedule. As the organism grows from birth, a variety of body functions develop, including the ability to reproduce. From a purely biological perspective, living organisms exist to procreate and, in the case of animals, nurture their offspring until they themselves are independent. Humans have higher aspirations than these purely biologic imperatives. All living things change with increasing age, and eventually when they are older, they experience age-related changes which affect function and which ultimately make the organism more prone to disease, disability, and death. All living things have a finite maximum life span described as the maximum period of time that a member of the species has lived. Maximum life span is also species specific. Usually only a few members of the species live to or close to the species specific maximum life span. Maximum human life span is thought to be somewhere in the range of 120 to 125 years, though the unreliability of birth records makes it difficult to know for sure whether these figures have been surpassed.

Old Age

Identifying when an organism becomes old is an arbitrary delineation. The term old age is used in an inconsistent manner. The term extreme old age is also used and with equal inconsistency. As with beauty, old age is often in the eye of the beholder. There is a great variation in defining characteristics which signify old age. 20-year-olds have different perceptions about what constitutes being old from that of 65-year-olds. The Pew Research Center has conducted surveys to get a better sense of when different age cohorts consider someone to be old [1] (Fig. 1.1). It is no surprise that older respondents considered old age to occur later than younger respondents did. There were also significant generational differences between what younger and older survey responders consider markers of old age (Fig. 1.2). It was also noted that though younger respondents often stated that they felt as old as their chronological age, with increasing age, respondents were more likely to say that they felt younger than their chronological age (Fig. 1.3).

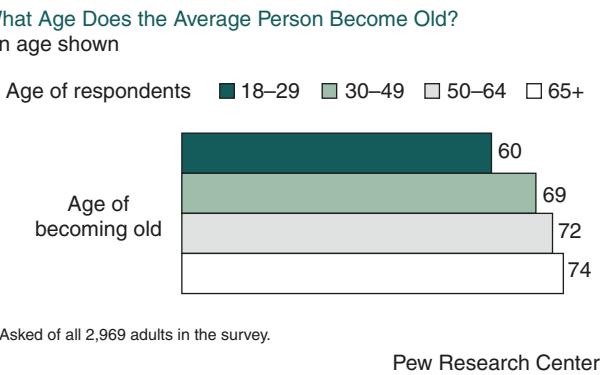


Fig. 1.1 Age dependent responses to the question "At what age does the average person become old?"

P. P. Coll (✉)
Center on Aging and Departments of Family Medicine and Medicine, University of Connecticut School of Medicine, Farmington, CT, USA
e-mail: coll@uchc.edu

P. P. Coll (ed.), *Healthy Aging*, https://doi.org/10.1007/978-3-030-06200-2_1

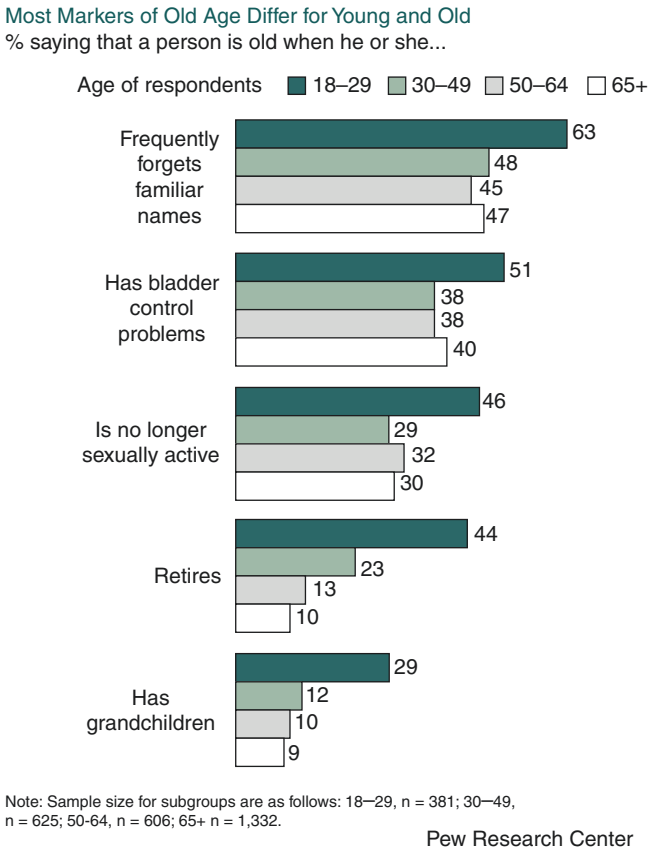


Fig. 1.2 Age dependent responses to questions regarding characteristics commonly associated with older age

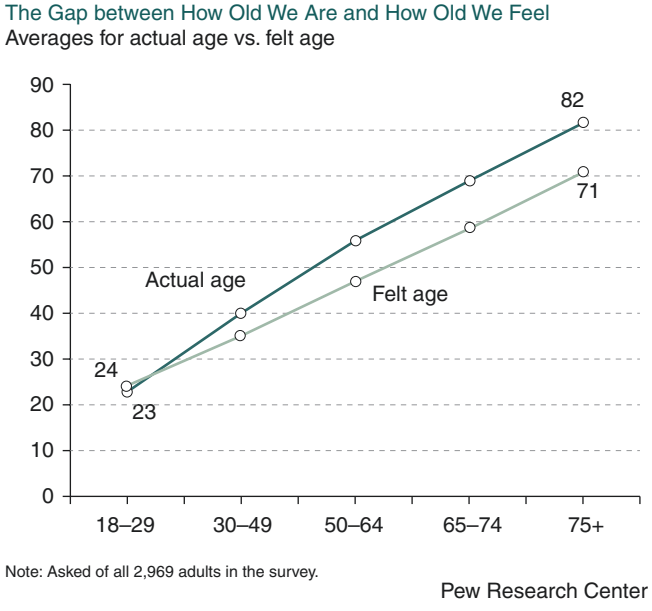


Fig. 1.3 How people of different ages respond to a question regarding how old they feel and how old they are

Age-Related Changes

The biological processes that determine the rate at which different organisms age are not well understood. There is clearly a significant genetic component. A human is old at 85 years of age and a dog is old at 15 years of age. Many dogs have age-related illness such as cataracts and osteoarthritis when they are 15; it takes another 50 years or more for these conditions to become common in humans. Many biological processes, including reproductive function, change with increasing age. Not all age-associated changes at a cellular or organ level occur at a similar rate. For example, it was understood for many years that there was an inevitable decrease in kidney function with increasing age. However, longitudinal data showed that though this was commonly the case, age-related decreases were variable among humans of a similar age and some older subjects did not experience any decrease in kidney function at all [2]. For a change to be purely age-related, the measured change should be the same in everybody of the same age. There are intrinsic factors which are responsible for these observed variations, but environmental factors also play a role. There are, for instance, intrinsic age-related changes in human skin, but sun exposure may be a more important factor in accelerating age-related changes in skin appearance and function [3]. Our diet, the air we breathe, the water we drink, the food we eat, the work we do, and the company we keep may all have an impact on body functions which are also affected by age. A disease may be age associated and may also accelerate age-related changes. For instance, diabetes mellitus increases in prevalence with increasing age, and diabetes accelerates age-related changes in organ function [4]. The multidirectional relationships between age, environment, and disease make it difficult to tease out the relative impact of each factor [5].

Human Demographics

Life expectancy is a statistical measure of the average time an organism is expected to live, based on the year of its birth or its current age. Human life expectancy is increasing worldwide. Over the last few centuries and especially in the last 100 years, an increasing percentage of humans are living into old age. In low-income countries, socioeconomic changes, including better sanitation, better nutrition, safer living and working environments, and safer means of transportation, are the primary initial determinants of increasing life expectancy. However, as a country becomes more prosperous, additional increases in life expectancy are more likely to be attributable to access to better medical care [6]. The prevention and treatment of infectious diseases and better prenatal and perinatal care have a big

impact on improved life expectancy at birth, since the young benefit most from these interventions [7]. Decreases in the number of people smoking cigarettes and improvements in cardiovascular health are major contributors to increasing life expectancy for adults [8, 9]. Increasing human longevity is generally a good thing. More of us now have the opportunity to see our children have children of their own and live productive and meaningful lives well beyond what was possible for the vast majority of our ancestors. However, as discussed in greater detail in subsequent chapters, living into old age sometimes comes at a price in terms of increased disease, disability, and dependency at the end of a long life.

Worldwide, human aging demographics are changing dramatically. In high-income countries, these changes are well underway. In low-income countries, dramatic changes are also taking place. Nations, such as Brazil and Thailand, are seeing much more rapid increases in the percentage of their population over 65 years of age than is the case for high-income countries, such as France and the United States [10]. In other words, the age wave that took several generations to materialize in high-income countries is materializing in low-income countries in only one or two generations. Increased human life expectancy leads to a higher percentage of older persons in a country's population. Human reproductively also has a significant impact on a country's ratio of younger to older residents. Low-income countries generally have both a lower life expectancy and a higher reproduction rate than high-income countries, and as a result, they currently have a smaller percentage of seniors in their population [11].

Though active, healthy, and engaged older persons can have a very positive effect on the social, cultural, and economic dimensions of society, the challenges posed by an aging demographic have received more attention. An increasing number of older citizens challenge a country's ability to adapt to an aging demographic. Many publicly funded programs and benefits for seniors were developed when the age demographics of the countries in which they were developed were very different from what they are today. Social security, which guarantees retirement income for most Americans, was introduced in the United States in 1935 [12]. In 1940, 5 years after the introduction of social security, the average life expectancy of a 65-year-old male in the United States was 12.7 years, and the average life expectancy of a 65-year-old woman was 14.7 years. Today, the average life expectancy of a 65-year-old male in the United States is 17.8 years, and the average life expectancy of a 65-year-old woman is 21.4 years. The total number of retired social security beneficiaries in 1950 was less than 3 million. Today, there are about 43 million retired social security beneficiaries receiving payments, at an annual cost of about 60 billion dollars. In 1950, there were 16.5 workers enrolled in social security for every retired beneficiary. Today, that ratio is less than 3 (Fig. 1.4) [13]. In addition to state-funded pension plans, government agencies across the world also provide medical insurance coverage for seniors, and some countries also provide state-supported long-term care. All of these programs are fiscally challenged by an increasing number of beneficiaries and a decreasing ratio of those who pay into the programs [14]. There are many efforts underway to recalibrate and optimize these programs to reflect changing demographics and burgeoning costs. These efforts include raising the retirement age, emphasizing the prevention of disease and disability, and efforts to provide community-based chronic

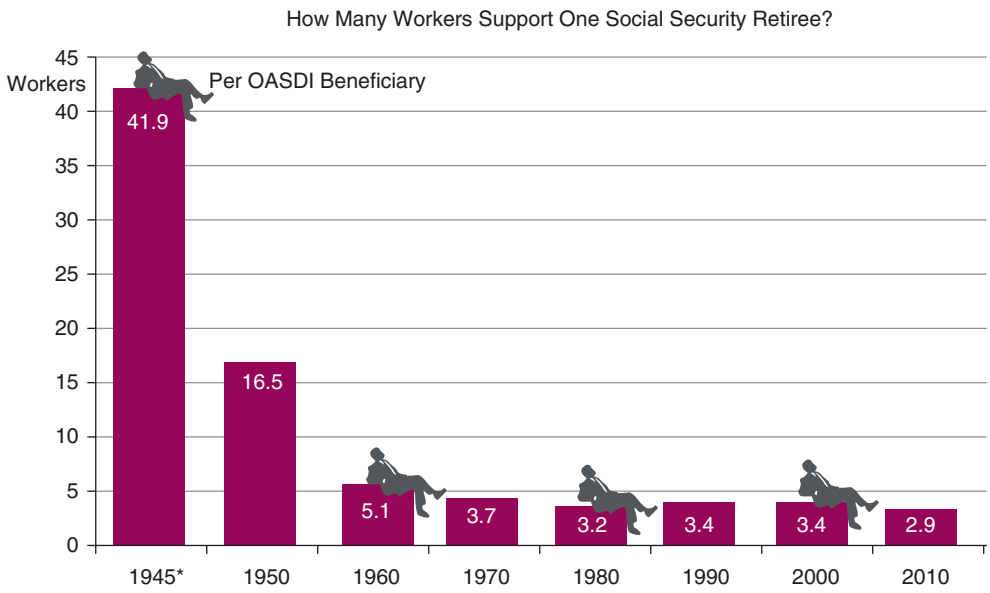


Fig. 1.4 The number of workers to social security retirees in the United States, 1945–2010

Source: 2012 OASDI Trustee Report, Table IV.B2., www.ssa.gov, accesssed May 21, 2012.
Data note: The Trustee Report provides data from 1945 and onward. Prior estimates are unavailable.
Produced by Veronique de Rugy Mercatus Center at George Mason University.

medical care management, which is both more cost-effective and what most seniors prefer [15].

Given the choice, most of us would want to live a long, happy, secure, fulfilling, and independent life and die following a brief illness. However, many are living with chronic diseases and associated disability in the later years of life. Moreover, many die after a long period of discomfort and need for assistance. Not only is this something we want to avoid, but the care needs of older patients with numerous chronic medical conditions and disabilities is a major contributor to the increasing cost of providing medical care for older persons [16]. A very large percentage of Medicare expenditures are the result of care provided for a relatively small number of Medicare beneficiaries who have multiple chronic medical conditions (Fig. 1.5) [17, 18].

Many would forego living into their late 90s or beyond if it meant that they had significant physical and/or psychological disabilities during that stage of their life [19]. In old age, quality of life is as important, if not more important, than quantity of life [20]. We do, however, need to be careful about the judgments we make regarding the quality of someone's life, or for that matter, their health. Though there are many ways to try and quantify quality of life and health, these measures remain largely subjective and person-specific [21]. There are large variations in the way individuals rate their quality of life and their health when objective measurement indicates that they are the same. There is frequently a discrepancy between how healthcare providers rate their patient's health and the way patients rate their own health, with healthcare providers being more likely to rate their patients' health poorer than the patient rates it [22]. It is important for us to keep this in mind as we encourage our patients to adopt lifestyles and interventions that we as healthcare providers believe will promote good health in old age or "healthy aging."

Healthy Aging

This book uses the term healthy aging. There are a variety of synonyms for healthy aging, including successful aging and optimal aging. There are some sensitivities regarding the terminology used, and I realize that healthy aging may not be to everyone's liking. There are also a variety of definitions of healthy aging provided by a variety of organizations. The World Health Organization (WHO) defines healthy aging as the process of developing and maintaining the functional ability that enables well-being in old age [23]. The European Healthy Ageing Project defines healthy aging as opportunities for physical, social, and mental health to enable older people to take an active part in society without discrimination and to enjoy an independent and good quality of life [24]. Health Canada describes healthy aging as a lifelong process of optimizing opportunities for improving and preserving health and physical, social, and mental wellness, independence, and quality of life and enhancing successful life-course transitions [25]. There is a growing awareness that social and psychological determinants of healthy aging may be more important than the biomedical determinants [26, 27]. This book will address both.

Within a species, including humans, there is a significant variation in the expression of age-related changes in physiol-

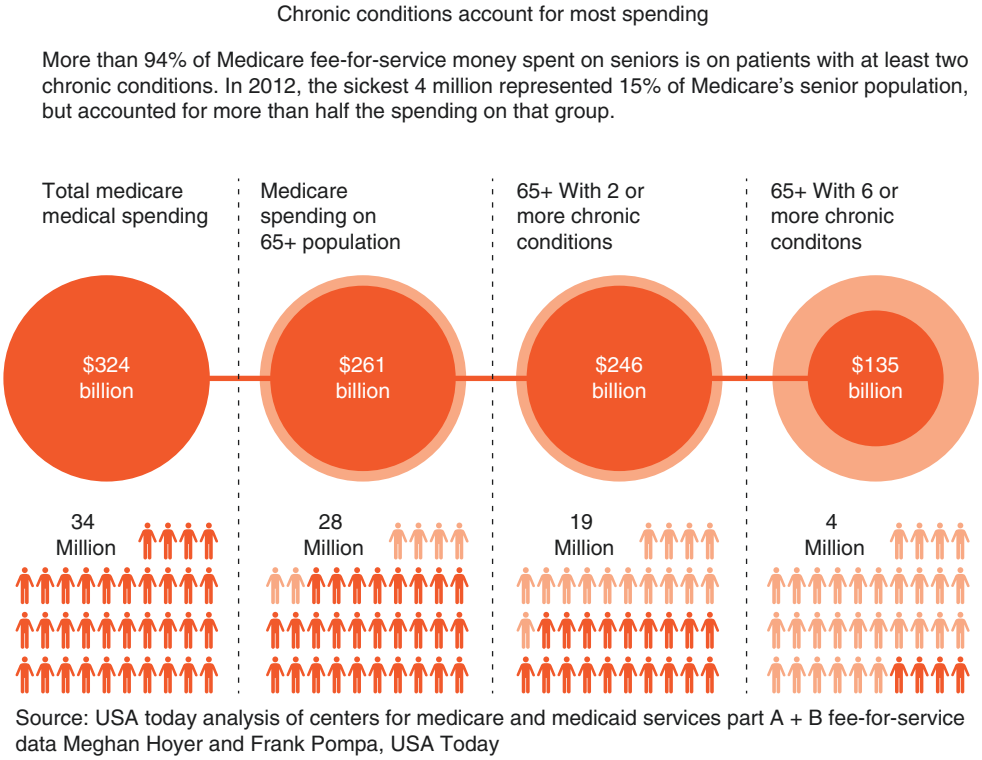
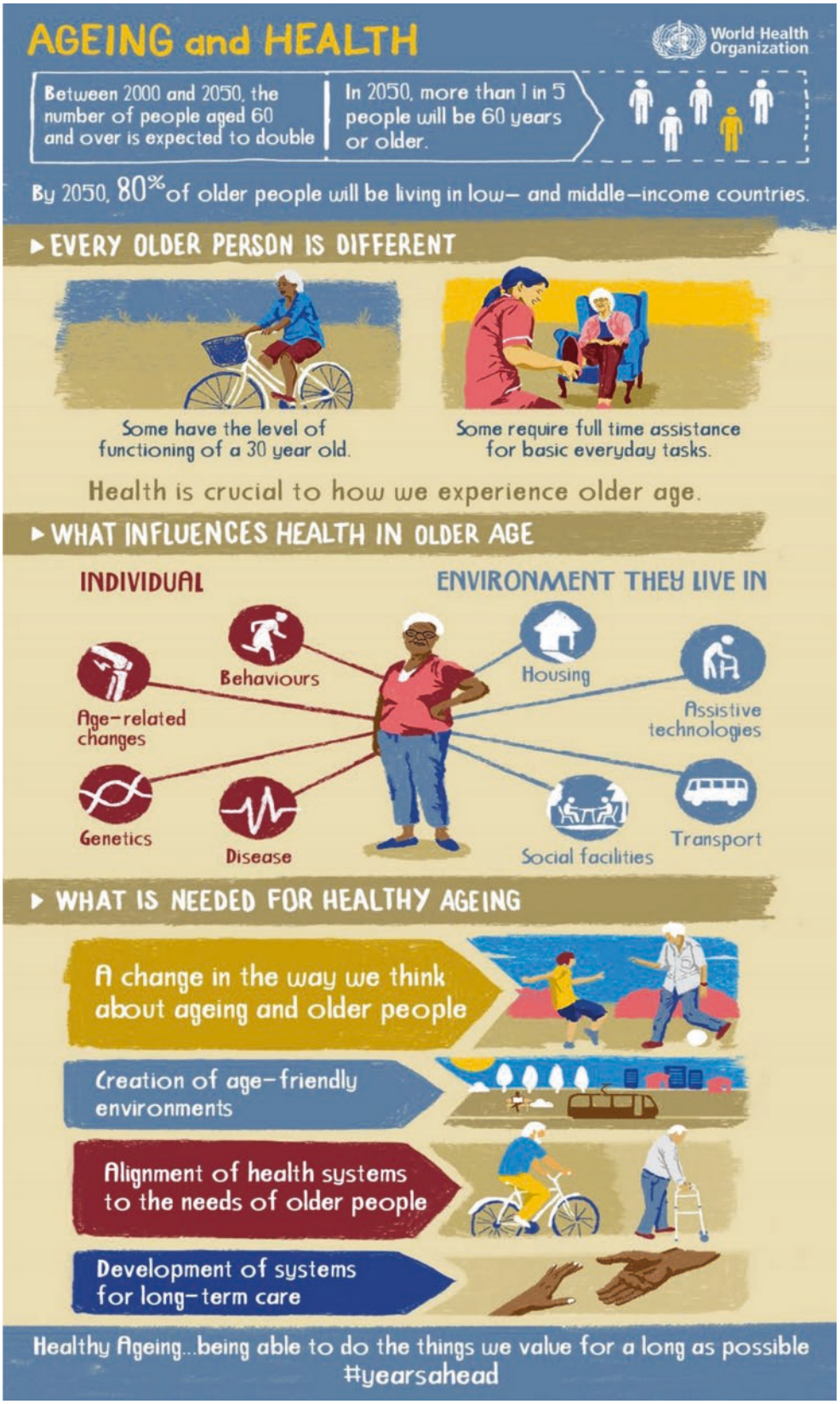


Fig. 1.5 The impact of the number of chronic medical conditions a patient has on Medicare spending in the United States in 2012

ogy, and there remains much to be understood about why this variation occurs. There is a growing field of research regarding interventions which may directly impact the rate at which complex organism age [28]. Much work has been done at the cellular level, and several interventions are being tested on multicellular organisms [29]. Human trials are beginning. Given the strong relationship between age and health, it is highly likely that if and when an intervention slows the rate at which an organism ages, this intervention will also result in better health in old age.



Why Healthy Aging Is Important

There are many personal, family, and societal benefits which accrue from good health. From a personal perspective, good health enables an older adult to be active, independent, happy, secure, and pain-free. From a family perspective, good health enables an older adult to engage in family activities, be supportive to other members of the family, and reduce the likelihood that the family will need to provide assistance for them. From a societal perspective, healthy older adults use fewer medical services and incur fewer medical costs. As discussed above, a very large percentage of healthcare spending supports the care of a relatively small number of older persons who have multiple chronic medical conditions. Lifetime medical expenses will depend on both the number of years lived and on how long an older person experiences multiple diseases and associated disability and dependency at the end of their life. There is a great amount of wisdom which accompanies old age [30]. Society benefits when its older members have an opportunity to share this wisdom and be active participants in society. Older adults can also, if they wish, remain in the workforce and be sufficiently active to volunteer and give back to society. Good health facilitates these contributions. As will be discussed in detail in a future chapter, there is now evidence that the promotion of healthy aging can reduce overall healthcare costs [31, 32].

The Scope of This Book

This book includes information and evidence-based interventions which support good health for those who are older. It also addresses interventions which those who are younger now can adopt to promote good health when they are older. It is broadly divided into four parts. The initial chapters provide information on the epidemiology of aging, old age, longevity, disease, and disability and the principles of disease prevention and health promotion. The following chapters address the biomedical determinants of healthy aging and the psychosocial determinants of healthy aging. The book ends with two chapters which address the role of health systems, healthcare funding, and public policy in promoting and supporting healthy aging.

There is occasional overlapping content between some of the chapters. For example, there is overlap between the musculoskeletal chapter and the exercise chapters, and there is overlap between the brain health and behavioral health chapters. Where overlapping content occurs, it has been kept to a minimum. It is, however, appropriate for there to be some overlap since each chapter can be accessed individually in the electronic version of the book.

Some readers may find omissions regarding what they believe should also have been covered. The most glaring of these may be the absence of a chapter which specifically addresses polypharmacy. Another may be the absence of a chapter on frailty. Both issues are addressed in the existing chapters of this book, with the appropriate use of medications being addressed in many of the chapters and frailty prevention being addressed extensively in the chapters on exercise and nutrition. Some may be concerned that there is not a chapter which specifically addresses advance directives and end-of-life care. There may be some who feel that the burgeoning field of senolytics should have been addressed. Because of a lack of clinical applicability at this time, the current iteration of this book will not address interventions which are designed to directly impact senescence at a cellular or subcellular level.

Summary

For the foreseeable future, an increasing number of older people and their propensity for chronic illness, disability, and associated high healthcare costs will require an increasing emphasis on promoting good health with increasing age. The promotion of healthy aging is important from both a personal, family, and societal perspective. The personal benefits to remaining disease and disability-free for as long as possible are clear. There are also societal benefits such as more older people participating as productive members of society and fewer older people requiring expensive healthcare services.

References

1. http://www.pewsocialtrends.org/2009/06/29/growing-old-in-america-expectations-vs-reality/. Accessed 31 July 2018.
2. Lindeman RD, Tobin J, Shock NW. Longitudinal studies on the rate of decline in renal function with age. J Am Geriatr Soc. 1985;33(4):278–85.
3. Jackson R. Elderly and sun-affected skin. Distinguishing between changes caused by aging and changes caused by habitual exposure to sun. Can Fam Physician. 2001;47:1236–43.
4. Bucala R. Diabetes, aging, and their tissue complications. J Clin Invest. 2014;124(5):1887–8.
5. Black D, O'Loughlin K, Kendig H, Wilson L. Cities, environment stressors, ageing and chronic disease. Australas J Ageing. 2012;31(3):147–51.
6. Mathers CD, Stevens GA, White TB, Tobias MI. Causes of international increase in older age life expectancy. Lancet. 2015;385:540–8.
7. Onarheim KH, Tessema S, Johansson KA, Norheim OF, Milieteig I. Prioritizing child health interventions in Ethiopia: modeling impact on child mortality, life expectancy and inequality in age at death. PLoS One. 2012;7(8):e41521.
8. Thun MJ, Apicella LF, Henley SJ. Smoking vs other risk factors as the cause of smoking-attributable deaths: confounding in the courtroom. JAMA. 2000;284:706–12.
9. Di Cesare M, Bennett JE, Best N, Stevens GA, Danaei G, Ezzati M. The contributions of risk factor trends to cardiometabolic mortality decline in 26 industrialized countries. Int J Epidemil. 2013;42(12):838–48.

10. Kinsella K, Phillips DR. Global aging: the challenges of success. Popul Bull. 2005;60(1). Washington, DC: Population Reference Bureau.
11. http://www.worldlifeexpectancy.com/world-population-pyramid. Accessed 1 Aug 2018.
12. https://www.ssa.gov/history/briefhistory3.html. Accessed 1 Aug 2018.
13. https://www.mercatus.org/publication/how-many-workers-support-one-social-security-retiree. Accessed 1 Aug 2018.
14. Ginsburg PB, Rivlin AM. Challenges for Medicare at 50. N Engl J Med. 2015;373:1993–5.
15. Nolte E, Knaj C, Hofmarcher M, Conklin A, et al. Overcoming fragmentation in health care: chronic care in Austria, Germany and The Netherlands. Health Econ Policy Law. 2012;7(1):125–46.
16. Picco L, Achilla E, Abdin E, Chong SA, et al. Economic burden of multimorbidity among older adults: impact on healthcare and societal costs. BMC Health Serv Res. 2016;16:173.
17. https://www.cbo.gov/sites/default/files/cbofiles/ftpdocs/63xx/doc6332/05-03-medispending.pdf. Accessed 1 Aug 2018.
18. https://www.usatoday.com/story/news/2015/06/05/medicare-costs-seniors-sick-chronic-conditions/27390925/. Accessed 1 Aug 2018.
19. Goering S. What makes suffering "unbearable and hopeless"? Advance directives, dementia and disability. Am J Bioeth. 2007;7(4):62–3.
20. Kanauchi M, Kubo A, Kanauchi K, Saito Y. Frailty, health-related quality of life and mental well-being in older adults with cardiometabolic risk factors. Int J Clin Pract. 2008;62(9):1447–51. https://doi.org/10.1111/j.1742-1241.2008.01830.x. Epub 2008 July 16.
21. Cella DF. Methods and problems in measuring quality of life. Support Care Cancer. 1995;3(1):11–22.
22. Unden AL, Elofesson S. Health from the patient's point of view. How does it relate to the physician's judgement? Fam Pract. 2001;18(2):174–80.
23. http://www.who.int/ageing/healthy-ageing/en/. Accessed 1 Aug 2018.
24. http://ec.europa.eu/health/ph_projects/2003/action1/docs/2003_1_26_frep_en.pdf. Accessed 1 Aug 2018.
25. http://publications.gc.ca/collections/Collection/H39-612-2002-1E.pdf. Accessed 1 Aug 2018.
26. Hunter RH, Anderson LA, Belza B, Bodiford K, et al. Environments for healthy aging: linking prevention research and public health practice. Prev Chronic Dis. 2013;10:E55. https://doi.org/10.5888/pcd10.120244.
27. Sowa A, Tobiasz-Adamczyk B, Topor-Madry R, Poscia A, Ignazio La Milia D. Predictors of healthy ageing: public health policy targets. BMC Health Serv Res. 2016;16(Suppl 5):289.
28. Kirkland JL, Tchkonia T, Zhu Y, Niedernhofer LJ, Robbins PD. The clinical potential of Senolytic drugs. J Am Geriatr Soc. 2017;65(10):2297–301. https://doi.org/10.1111/jgs.14969. Epub 2017 Sept 4.
29. Bussian TJ, Aziz A, Meyer CF, Swenson BL, van Deursen JM, Baker DJ. Clearance of senescent glial cells prevents tau-dependent pathology and cognitive decline. Nature. 2018 t 19;562:578. https://doi.org/10.1038/s41586-018-0543-y.
30. Lim KT, Yu R. Aging and wisdom: age-related changes in economic and social decision making. Front Aging Neurosci. 2015;7:120. https://doi.org/10.3389/fnagi.2015.00120. eCollection 2015.
31. Leigh JP, Hubert HB, Romano PS. Lifestyle risk factors predict healthcare costs in an aging cohort. Am J Prev Med. 2005;29(5):379–87.
32. Oldbridge NB. Economic burden of physical inactivity: healthcare costs associated with cardiovascular disease. Eur J Cardiovasc Prev Rehabil. 2008;15(2):130–9.

Disease, Disability, and Frailty with Increasing Age

2

Krupa Shah

Key Points

- The population in the world is rapidly growing older.
- Increased comorbidities, frailty, and disability often accompany aging.
- The change in demographics of the aging population will place a greater burden on healthcare systems.
- The promotion of healthy aging must become fundamental to future planning.

Changes in the Demographics of Aging

The world's population is rapidly growing older. Presently, 8.5% of the world's population (617 million) is aged 65 and over. This percentage is projected to increase to almost 17% by 2050 (1.6 billion) [1]. In the United States by 2050, the population aged 65 and over is projected to be more than 83.7 million, almost double the 43.1 million older adults in 2012 [2]. Currently in the United States, one in nine Americans is aged 65 years or older; by 2050, this will increase to one in five Americans [3].

This increasing number of older adults is the result of increasing life expectancy. Though the most dramatic increases in life expectancy have occurred in infants and children, life expectancy has also been increasing for those who are older. Life expectancy at age 65 has increased dramatically in the past three to four decades, and life expectancy for older adults is continuing to increase. Today, a person in the United States who is 65 years of age is projected to live another 15–20 years [3]. Increasing life expectancy occurred first in high-income countries, but low-income countries are now also witnessing dramatic increases in life expectancy. Increasing life expectancy in low-income countries is also occurring in a much shorter period of time. In 1950, life expectancy at birth was 65 years in high-income countries and 42 years in low-income countries. Currently, life expectancy is 78 years in the high-income countries and 68 years in low-income countries [4]. The proportion of the population aged 80 years and older—the oldest old—is increasing at an even greater rate. In 1950, the number of adults aged 80 years and older was estimated to be six million in low-income countries and eight million in high-income countries. By 2050, these numbers are projected to increase to 268 million in low-income countries and 124 million in high-income countries [5]. The number and proportion of centenarians (people aged 100 years or more) is growing even faster. The number of centenarians in the world is projected to increase rapidly from approximately 441,000 in 2013 to 3.4 million in 2050 and 20.1 million in 2100 [5].

Burden of Diseases and Comorbidities with Aging

In general, the risk of developing most diseases increases progressively with age. The prevalence and severity of comorbidities is significantly higher in the older population. An estimated two of every three older Americans have multiple chronic conditions, and almost 60% of medical office visits occur for those older than 75 years of age [4]. Although multimorbidity (co-occurrence of two or more comorbidities) is not limited to older adults, its prevalence increases substantially with age. There is a strong association between multimorbidity and age, with age being the main risk factor for prevalent and incident multimorbidity [6]. In a cross-sectional

K. Shah (✉)
Division of Geriatrics and Aging, Department of Medicine, University of Rochester School of Medicine, Rochester, NY, USA
e-mail: krupa_shah@urmc.rochester.edu

P. P. Coll (ed.), *Healthy Aging*, https://doi.org/10.1007/978-3-030-06200-2_2

study that included 1.7 million individuals, it was found that approximately 30% of the population aged 45–64 years, 65% of the population aged 65–84 years, and 82% of the population aged 85 years or older reported at least two chronic medical conditions [7]. Increasing multimorbidity with age is not linear. Multimorbidity increases significantly when people achieve older ages [8].

There are several chronic diseases which are common in older adults including dementia, cardiovascular disease, cerebrovascular disease, chronic obstructive pulmonary disease, diabetes, cancer, and depression. In addition to aging, a number of other important risk factors are associated with the development of chronic disease. These include lifestyle habits such as tobacco smoking and alcohol intake, over- or undernutrition, inactivity, and occupational exposures.

Dementia

Dementia is associated with a decline in cognitive ability, including memory and speech, and eventually results in impaired function and the ability to live independently. With the burgeoning older population, the increasing prevalence of dementia will have a great impact not only on those afflicted but also their families, the healthcare system, and society in general. In 2010, the estimated prevalence of dementia among Americans older than 70 years was 14.7% [9]. Alzheimer's disease is the most common form of dementia and accounts for 50–80% of all cases of dementia. In 2014, an estimated 5.2 million Americans were diagnosed with Alzheimer's disease, including an estimated 5.0 million people aged 65 years and older [10]. With the increasing number of people falling into the old or very old age groups, the annual incidence of Alzheimer's and other dementias is projected to double by 2050. Alzheimer's disease is one of the costliest chronic diseases due to high healthcare, long-term care, and hospice care expenses. The worldwide costs of dementia in 2015 are estimated to be $818 billion, which is a 35% increase since 2010. 86% of these costs occurred in high-income countries [11].

Obesity

Obesity is a risk factor for many chronic conditions, including type 2 diabetes, hypertension, hyperlipidemia, stroke, heart disease, cancer (endometrial, colon, breast), and arthritis [12]. Higher levels of obesity are associated with excess morbidity, primarily from cardiovascular disease, diabetes, and certain cancers. The worldwide prevalence of obesity nearly tripled between 1975 and 2016. This increase in the prevalence of obesity is also evident in older age groups [13]. More than one-third of older adults aged 65 and over were obese in 2007–2010. Obesity prevalence for older adults peaked in the late 1970s with a higher obesity prevalence among those aged 65–74 compared with those aged 75 and over, in both men and women [12]. This may be related to the fact that since obesity is associated with so many serious life-threatening diseases, those with obesity are less likely to survive into the oldest age groups. Between 1999 and 2010, the prevalence of obesity among older men also increased.

Diabetes

One-third of older adults have diabetes, and three-quarters of older adults have prediabetes or diabetes [14]. With the aging of the population, the Centers for Disease Control and Prevention (CDC) projects that the prevalence of diabetes will double in the next 20 years. Another projection states that there will be a fourfold increase in the diagnosis of diabetes in adults older than 65 years between 2005 and 2055. Older patients with diabetes experience greater morbidity and mortality from higher rates of acute and chronic microvascular and cardiovascular complications associated with the disease [14]. Diabetes in older adults is associated with increased risk of hospitalization, falls, decreased functional status, and depression.

COPD

There is increasing evidence for a close relationship between aging and chronic inflammatory diseases. COPD is a chronic inflammatory disease of the lungs, which progresses very slowly and which has a high prevalence in older adults. The prevalence of COPD is two to three times higher in people over the age of 60 years of age than in younger age groups [15]. COPD is a major cause of morbidity and mortality worldwide and results in an economic and social burden that is both substantial and increasing. COPD accounts for one-fifth of all hospitalizations in individuals aged 75 years and older [16]. Finally, older COPD patient can experience impaired functional status and mood and overall decline in their quality of life.

Cancer

Cancer is one of the leading causes of morbidity and mortality worldwide. The incidence of most cancers increases with age. With the aging of the population, a significant increase in the number of cancer diagnoses is anticipated. It is projected that between 2010 and 2030, there will be a 67% increase in cancer incidence for patients aged 65 years or older [17]. Breast, colon and rectum, lung, and uterine cancers

are the leading cancers in women, whereas prostate, lung, colon and rectum, and bladder cancers are the most common cancers in men.

Depression

The CDC estimates that seven million American adults over the age of 65 experience depression each year. Older patients with symptoms of depression have roughly 50% higher healthcare costs than non-depressed seniors. Depression leads to significant distress and is associated with adverse functional, social, and medical outcomes [18]. It is a risk factor for increased non-suicide mortality in older adults and suicide in older adults. Functional impairment from depression may overwhelm caregivers and lead to long-term care facility placement [19]. It may also interfere with treatment for other common geriatric medical problems such as stroke and dementias. Impaired motivation from depression further limits rehabilitation efforts and worsens outcomes.

Cardiovascular Disease

Cardiovascular diseases (CVD) are the leading cause of death for the population over 65 years of age. Aging results in structural changes and functional decline of the cardiovascular system and is a major risk factor for CVD. Aging not only increases the prevalence of cardiovascular diseases but is also associated with impaired responses to cardiovascular diseases [20]. CVD accounts for 10% of the global burden of disability-adjusted life-years and almost a third of all deaths worldwide [21]. People who are physically inactive or obese or have hyperlipidemia, diabetes, or hypertension are at risk of CVD. Disability and death due to CVD is high in high-income countries and has become increasingly common in low-income countries [22].

Disability

Activities of daily living (ADL) are the essential activities that a person needs to perform to be able to live independently. With advancing age, functional capacity in performing advanced (e.g., instrumental) ADL and even basic (e.g., self-care) ADL becomes increasingly difficult, and thus there is an increase in prevalence of ADL disability in later years of life [23]. About half of adults aged 65 years and older report some limitations in physical functioning such as walking, pushing, carrying, etc. [24]. Both chronic comorbidities including progressive diseases (such as arthritis and heart disease) and acute conditions (such as hip fracture or acute stroke) that are common in those who are older, are the major causes of physical disability. In addition, the increased prevalence of obesity in older adults continues to be a growing concern for disability in this cohort [25]. As the population continues to age, disability is becoming increasingly important, given its negative impact on independence and quality of life and associated increased healthcare expenditure [26]. Finally, persons with disabilities are underemployed and poverty rates are considerably higher [27].

Clinical Challenges of Multiple Comorbidities

Multiple comorbidities contribute to poor clinical outcomes. Comorbidities result in functional decline and a reduced quality of life [6]. One study showed that even one newly diagnosed chronic condition is associated with nearly twice the odds of developing an ADL disability [28]. Mental health conditions, in particular, present the strongest association with poor quality of life and functional impairment [19]. Indeed, growing evidence shows that multimorbidity is an important predictor of mortality, with life expectancy substantially declining as the number of chronic condition increases [29]. Furthermore, patients with multiple chronic diseases are more likely to experience polypharmacy, reduced compliance, greater vulnerability to adverse events, increased psychological distress and depression, and frequent hospitalizations and face longer hospital stays [6]. Finally, multimorbidity is associated with higher healthcare utilization and healthcare expenditure [30].

Frailty Definition, Epidemiology, and Consequences

Frailty Definition and Phenotypes

Frailty is often defined as a biologic syndrome of decreased reserve and resistance to stressors, resulting from cumulative decline within multiple physiologic systems which can cause vulnerability to adverse outcomes [31]. Frailty is an important geriatric syndrome as it represents an elevated risk of functional and health decline among older adults. As a syndrome, frailty is identified by a cluster of signs and symptoms which form its clinical profile known as frailty clinical phenotype. The most well-researched cluster is the physical frailty phenotype described by Fried et al. [32]. Ongoing frailty research continues to expand the definition of frailty to include a more multidimensional delineation of frailty involving multiple domains including cognitive, functional, and social domains.

The physical frailty phenotype includes five clinical indicators: (1) shrinking with weight loss and sarcopenia, (2) weakness with low grip strength, (3) exhaustion or poor endurance,

(4) slow motor performance (e.g., slow walking speed, decreased balance), and (5) low physical activity as a marker of low energy expenditure [32]. Based on these indicators, the physical frailty phenotype classifies people into categories of robust, pre-frail, or frail. A person with none of the indicators is robust, a person with one or two indicators is pre-frail, and a person with three or more indicators is frail. Individuals who are frail according to this phenotype have a higher risk of disability and other related adverse outcomes [32].

Frailty is also described as an accumulation of multiple deficits (impaired continence, walking, cognition, and ADL disability) by a working group led by Rockwood et al. [33]. Further development of the accumulated deficit model included more than 70 items in several domains (cognition, mood, motivation, communication, mobility, balance, ADL, bowel and bladder functions, nutrition, comorbidities, and social resources) aggregated as the "Frailty Index." A 7-point frailty scale was created based on Frailty Index scores which predict risk for mortality and institutionalization.

Epidemiology of Frailty

Frailty is common in older people. Cumulative literature shows that the prevalence of frailty in community-dwelling elderly adults is widely variable, ranging from 4% to 59% [34]. The literature also documents that the prevalence of frailty increases with advancing age, greater number of comorbid conditions, and lower education and income. Indeed, the prevalence of frailty increases with each 5-year age group (about 3% among 65–70 years; 5% among 71–74 years; 10% among 75–79 years; 16% among 80–85 years; 25% over 86 years) [32]. Furthermore, frailty is also more prevalent in women compared to men, and its prevalence is also higher among nursing home residents than in community-dwelling people. In one study, as high as one-half of nursing home residents were frail [35]. However, this finding can be explained by the fact that institutionalization could be a consequence of developing frailty.

Consequences and Burden of Frailty

Frail individuals are more vulnerable to functional decline and several adverse health outcomes (falls, disability, hospitalization, long-term admission, morbidity, and mortality) (Fig. 2.1). Indeed, the association between frailty and adverse outcomes has been reported in several large cohort studies. The Cardiovascular Health Study (CHS) shows a predictive association between frailty with falls, worsened mobility or

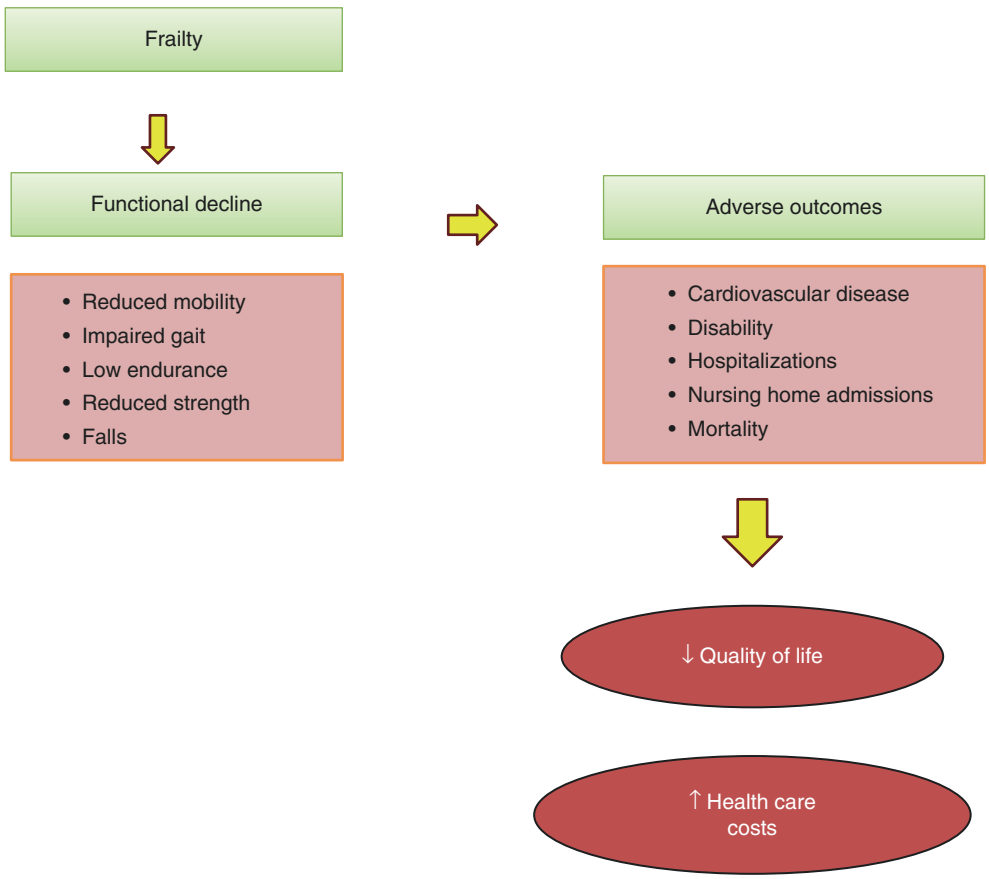


Fig. 2.1 Frailty and its consequences

ADL disability, incident hospitalization, and death over three or seven years of follow-up [32]. Another study documented that frailty was associated with an increased five-year risk for death, with odds of mortality greater with increasing evidence of frailty. Moreover, in this study, frailty was the most important predictor for both death and institutionalization. Finally, the cumulative literature supports that the risk for adverse health outcomes increased significantly with frailty, and these risks persist after adjustments for age, gender, and comorbid conditions.

Disability is an important adverse outcome of frailty that places a high burden on frail individuals, care professionals, and healthcare systems. Frail older adults have a higher risk of ADL disability compared to non-frail older adults. In one study, frailty was associated with two or more falls in the subsequent year, and the likelihood of developing a new disability (≥1 new ADL impairment) was greater with increasing evidence of frailty [36].

Frailty is a dynamic process that can evolve (improve or deteriorate) over time. However, deterioration is more common than improvement. Emergence of frailty frequently results in a spiral of decline that not only leads to worsening in the status of frailty but also can lead to increased disability, falls, frequent hospitalizations, and death. In one epidemiological study, greater than half the participants had at least one transition between any two of the three frailty states (i.e., non-frail, pre-frail, and frail) [37].

The frailty syndrome has attracted the attention of scientific communities and public health organizations. Frailty screening can identify people in need of additional medical attention and at risk for loss of independence. There are potential financial benefits of screening older adults for frailty, although there is limited evidence on the economic implications of interventions targeting the prevention of frailty. For the development of such interventions and the identification of people who might benefit from them, it is important to know which factors predict frailty-related disability. Identification of cost-effective prevention programs to reduce frailty may help health services to efficiently allocate healthcare resources to those older people most at risk and thus improve their health outcomes and quality of life. A lifelong approach to promote healthy aging interventions that prevent disability, reduce morbidity, and diminish the burdens caused by frailty is warranted.

Conclusion

Life expectancy has increased dramatically in the last century with a marked increase in the population growth of older adults. Increased comorbidities, frailty, and disability frequently accompany aging, and these conditions strain social and healthcare services immensely. The promotion of healthy aging and the prevention or reduction of morbidity and disability for older adults must be a key component of current and future health and social policies. An all-encompassing lifelong approach to health promotion and appropriate interventions at all stages of life are needed.

References

1. An Aging World: 2015. https://www.census.gov/content/dam/Census/library/publications/2016/demo/p95-16-1.pdf. Date accessed 6/5/18.
2. https://www.census.gov/prod/2014pubs/p25-1140.pdf. Date accessed 6/10/18.
3. Halaweish I, Alam HB. Changing demographics of the American population. Surg Clin. 95(1):1–10.
4. Divo MJ, Martinez CH, Mannino DM. Ageing and the epidemiology of multimorbidity. Eur Respir J. 2014;44(4):1055–68.
5. http://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeingReport2013. Date accessed 6/10/18.
6. Fabbri E, Zoli M, Gonzalez-Freire M, Salive ME, Studenski SA, Ferrucci L. Aging and multimorbidity: new tasks, priorities, and frontiers for integrated gerontological and clinical research. J Am Med Dir Assoc. 2015;16(8):640–7.
7. Barnett K, Mercer SW, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. Lancet. 2012;380(9836):37–43.
8. Fabbri E, An Y, Zoli M, Simonsick EM, Guralnik JM, Bandinelli S, et al. Aging and the burden of multimorbidity: associations with inflammatory and anabolic hormonal biomarkers. J Gerontol A Biol Sci Med Sci. 2015;70(1):63–70.
9. Hurd MD, Martorell P, Delavande A, Mullen KJ, Langa KM. Monetary Costs of Dementia in the United States. N Engl J MedN Engl J Med. 2013;368(14):1326–34.
10. Alzheimer's Association. 2013 Alzheimer's disease facts and figures. Alzheimers Dement. 2013;9(2):208–45.
11. Wimo A, Guerchet M, Ali G-C, Wu Y-T, Prina AM, Winblad B, et al. The worldwide costs of dementia 2015 and comparisons with 2010. Alzheimers Dement. 2017;13(1):1–7.
12. Villareal DT, Apovian CM, Kushner RF, Klein S. Obesity in older adults: technical review and position statement of the American Society for Nutrition and NAASO, The Obesity Society. Am J Clin Nutr. 2005;82(5):923–34. [also published in: *Obes Res*. 2005: 13:1849–63].
13. http://www.who.int/mediacentre/factsheets/fs311/en/. Date accessed 6/1/1814.
14. Corriere M, Rooparinesingh N, Kalyani RR. Epidemiology of diabetes and diabetes complications in the elderly: an emerging public health burden. Curr Diab Rep. 2013;13(6):805. https://doi.org/10.1007/s11892-013-0425-5.
15. Lowery EM, Brubaker AL, Kuhlmann E, Kovacs EJ. The aging lung. Clin Interv Aging. 2013;8:1489–96.
16. Baillargeon J, Wang Y, Kuo Y-F, Holmes HM, Sharma G. Temporal trends in hospitalization rates for older adults with chronic obstructive pulmonary disease. Am J Med. 2013;126(7):607. https://doi.org/10.1016/j.amjmed.2013.01.035.
17. Smith BD, Smith GL, Hurria A, Hortobagyi GN, Buchholz TA. Future of cancer incidence in the United States: burdens upon an aging, changing nation. J Clin Oncol. 2009;27(17):2758–65.
18. Bjorklof GH, Engedal K, Selbaek G, Kouwenhoven SE, Helvik AS. Coping and depression in old age: a literature review. Dement Geriatr Cogn Disord. 2013;35(3–4):121–54.

19. Perissinotto CM, Stijacic Cenzer I, Covinsky KE. Loneliness in older persons: a predictor of functional decline and death. Arch Intern Med. 2012;172(14):1078–83.
20. Steenman M, Lande G. Cardiac aging and heart disease in humans. Biophys Rev. 2017;9(2):131–7.
21. Koopman JJE, Kuipers RS. From arterial ageing to cardiovascular disease. Lancet. 2017;389(10080):1676–8.
22. Global atlas on cardiovascular disease prevention and control. http://www.who.int/cardiovascular_diseases/publications/atlas_cvd/en/. Date accessed 6/13/18.
23. Lin S-F, Beck AN, Finch BK, Hummer RA, Master RK. Trends in US older adult disability: exploring age, period, and cohort effects. Am J Public Health. 2012;102(11):2157–63.
24. Motl RW, McAuley E. Physical activity, disability, and quality of life in older adults. Phys Med Rehabil Clin N Am. 2010;21(2):299–308.
25. Himes CL, Reynolds SL. Effect of obesity on falls, injury, and disability. J Am Geriatr Soc. 2012;60(1):124–9.
26. https://www.cdc.gov/ncbddd/disabilityandhealth/data-highlights.html. Date accessed 6/13/18.
27. Vornholt K, Villotti P, Muschalla B, Bauer J, Colella A, Zijlstra F, et al. Disability and employment – overview and highlights. Eur J Work Organ Psy. 2018;27(1):40–55.
28. Wolff JL, Boult C, Boyd C, Anderson G. Newly reported chronic conditions and onset of functional dependency. J Am Geriatr Soc. 2005;53(5):851–5.
29. DuGoff EH, Canudas-Romo V, Buttorff C, Leff B, Anderson GF. Multiple chronic conditions and life expectancy: a life table analysis. Med Care. 2014;52(8):688–94.
30. Bahler C, Huber CA, Brungger B, Reich O. Multimorbidity, health care utilization and costs in an elderly community-dwelling population: a claims data based observational study. BMC Health Serv Res. 2015;15:23.
31. Morley JE, Vellas B, van Kan GA, Anker SD, Bauer JM, Bernabei R, et al. Frailty consensus: a call to action. J Am Med Dir Assoc. 2013;14(6):392–7.
32. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci. 2001;56(3):M146–M56.
33. Rockwood K, Song X, MacKnight C, Bergman H, Hogan DB, McDowell I, et al. A global clinical measure of fitness and frailty in elderly people. CMAJ. 2005;173(5):489–95.
34. Collard RM, Boter H, Schoevers RA, Oude Voshaar RC. Prevalence of frailty in community-dwelling older persons: a systematic review. J Am Geriatr Soc. 2012;60(8):1487–92.
35. Kojima G. Prevalence of frailty in nursing homes: a systematic review and meta-analysis. J Am Med Dir Assoc. 2015;16(11):940–5.
36. Ensrud KE, Ewing SK, Taylor BC, Fink HA, Cawthon PM, Stone KL, et al. Comparison of 2 frailty indexes for prediction of falls, disability, fractures, and death in older women. Arch Intern Med. 2008;168(4):382–9.
37. Gill TM, Gahbauer EA, Allore HG, Han L. Transitions between frailty states among community-living older persons. Arch Intern Med. 2006;166(4):418–23.

The Principles of Disease and Disability Prevention and Health Promotion with Increasing Age

3

Neema Sharda, Kathryn Daniel, and Heidi White

Introduction

As a 100-year-old woman once stated, "If I'd known I was gonna live this long, I'd have taken better care of myself" [1]. This statement challenges clinicians involved in the care of older adults to thoughtfully consider the principles of disease and disability prevention and health promotion for this population. What methods of disease prevention are most effective, when, and at what cost to society and the individual? Is health promotion only for the healthy or can it be applied to those who are not "aging well?" The usual framework geriatric specialists follow sometimes referred to by a newly coined mantra of the "5Ms" (i.e., mind, mobility, medications, multicomplexity, and what matters most) [2] is insufficient because it remains primarily a medical model. As we think about preventing disease and disability for the older adult and move forward to establish new methods of health promotion, we have to recognize not only the impact of the physiology of aging (e.g., reduced renal function, changes in muscle versus adipose tissue, and musculoskeletal alterations) but also the patient as a whole in their environment. We must start with a model that will allow us to consider and manipulate all of the factors that contribute to health and function while minimizing disability. In its International Classification of Functioning, Disability and Health, the World Health Organization has combined the medical model of disease with a social model of disability. In this biopsychosocial model (Fig. 3.1), the outcome of interest is activity (i.e., the execution of a task or action), which can be applied to an individual or population [3]. Activity is influenced simultaneously by disease, body function, structure (i.e., including impairments), and participation, including life situation such as work, community participation, or leisure activities. Importantly, environmental and personal factors provide a context that influence activity achievement. Extrinsic environmental factors (e.g., social attitudes, culture, architectural characteristics, climate, and food availability) should certainly be taken into account. Also, intrinsic personal factors such as gender, age, coping styles, education, experiences, and preferences influence how disability and disease is experienced by the individual. This framework provides an appropriate target/outcome, activity, for application of disease prevention and health promotion for older adults.

This chapter will explain the principles of disease and disability prevention that allows for application across a spectrum of older adults. Statistical considerations important to this population will be discussed such as life expectancy, risk reduction, and measures of impact such as number needed to treat and number needed to harm. Current approaches to community-centric health promotion through advocacy,

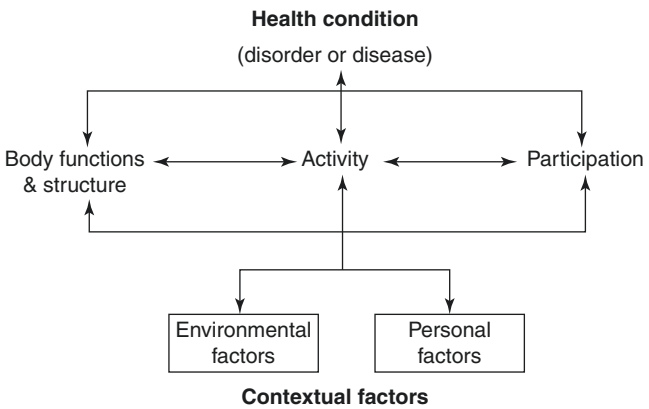


Fig. 3.1 Interactions between the components of ICF (International Classification of Functioning) (WHO 2001:18) [3]

N. Sharda (✉) · H. White
Geriatrics Division, Duke University School of Medicine, Durham, NC, USA
e-mail: Neema.Sharda@duke.edu; Heidi.White@duke.edu

K. Daniel
College of Nursing and Health Innovation, University of Texas at Arlington, Arlington, TX, USA
e-mail: kdaniel@uta.edu

P. P. Coll (ed.), *Healthy Aging*, https://doi.org/10.1007/978-3-030-06200-2_3

education, best clinical practice, and research will be outlined, emphasizing the expanse of disciplines and professional expertise required. As we pursue health promotion, it is important to consider the undertones of the language we use and to work to dispel ageism in ourselves and others that would hinder progress. Finally, the importance of shared decision-making will be highlighted as we apply these principles to individual older adults.

Disease and Disability Prevention

The US Preventive Services Task Force has made multiple recommendations for patients older than 65 (Table 3.1) [4], and the Centers for Disease Control and Prevention recommends certain immunizations for patients older than 65 (Table 3.2) [5]. But optimally, disease and disability prevention begins well before turning 65 years of age.

Table 3.1 USPSTF A and B Recommendations (adapted) [4]

Topic	Description	Grade	Release date of current recommendation
Abdominal aortic aneurysm: men	The USPSTF recommends onetime screening for abdominal aortic aneurysm by ultrasonography in men ages 65 to 75 years who have ever smoked	B	June 2014
Alcohol misuse: screening and counseling	The USPSTF recommends that clinicians screen adults age 18 years or older for alcohol misuse and provide persons engaged in risky or hazardous drinking with brief behavioral counseling interventions to reduce alcohol misuse	B	May 2013
Blood pressure screening: adults	The USPSTF recommends screening for high blood pressure in adults aged 18 years or older. The USPSTF recommends obtaining measurements outside of the clinical setting for diagnostic confirmation before starting treatment	A	October 2015
Breast cancer screening	The USPSTF recommends screening mammography for women, with or without clinical breast examination, every 1 to 2 years for women age 40 years and older	B	September 2002
Colorectal cancer screening	The USPSTF recommends screening for colorectal cancer starting at age 50 years and continuing until age 75 years	A	June 2016
Depression screening: adults	The USPSTF recommends screening for depression in the general adult population, including pregnant and postpartum women. Screening should be implemented with adequate systems in place to ensure accurate diagnosis, effective treatment, and appropriate follow-up	B	January 2016
Diabetes screening	The USPSTF recommends screening for abnormal blood glucose as part of cardiovascular risk assessment in adults aged 40 to 70 years who are overweight or obese. Clinicians should offer or refer patients with abnormal blood glucose to intensive behavioral counseling interventions to promote a healthful diet and physical activity	B	October 2015
Falls prevention: older adults	The USPSTF recommends exercise interventions to prevent falls in community-dwelling adults 65 years or older who are at increased risk for falls	B	April 2018
Hepatitis C virus infection screening: adults	The USPSTF recommends screening for hepatitis C virus (HCV) infection in persons at high risk for infection. The USPSTF also recommends offering onetime screening for HCV infection to adults born between 1945 and 1965	B	June 2013
Lung cancer screening	The USPSTF recommends annual screening for lung cancer with low-dose computed tomography in adults ages 55 to 80 years who have a 30 pack-year smoking history and currently smoke or have quit within the past 15 years. Screening should be discontinued once a person has not smoked for 15 years or develops a health problem that substantially limits life expectancy or the ability or willingness to have curative lung surgery	B	December 2013
Osteoporosis screening: women	The USPSTF recommends screening for osteoporosis in women age 65 years and older and in younger women whose fracture risk is equal to or greater than that of a 65-year-old white woman who has no additional risk factors	B	January 2012
Statin preventive medication: adults ages 40–75 years with no history of CVD, 1 or more CVD risk factors, and a calculated 10-year CVD event risk of 10% or greater	The USPSTF recommends that adults without a history of cardiovascular disease (CVD) (i.e., symptomatic coronary artery disease or ischemic stroke) use a low- to moderate-dose statin for the prevention of CVD events and mortality when all of the following criteria are met: (1) they are ages 40 to 75 years; (2) they have 1 or more CVD risk factors (i.e., dyslipidemia, diabetes, hypertension, or smoking); and (3) they have a calculated 10-year risk of a cardiovascular event of 10% or greater. Identification of dyslipidemia and calculation of 10-year CVD event risk require universal lipids screening in adults ages 40 to 75 years	B	November 2016

Table 3.2 Recommended immunizations by the CDC for adults ≥65 years [5]

Influenza	1 dose annually
Tdap or Td	1 dose Tdap and then Td booster every 10 years
Varicella	2 doses
Zoster	2 doses of recombinant zoster vaccine (2–6 months apart, age ≥ 50) or 1 dose of zoster vaccine live
Pneumococcal (PCV 13)	1 dose
Pneumococcal (PPSV 23)	1 dose

Table 3.3 Factors that require consideration when recommending a disease prevention or health promotion intervention

Consideration	Example
What you are trying to prevent or promote	Myocardial infarction
	Good balance
	Loneliness
The epidemiology of what you are trying to prevent or promote	Age-related incidence
	Prevalence
	The rate at which the condition progresses
The efficacy of the intervention you are considering	Sensitivity
	Number needed to treat
The patient's life expectancy	Overall life expectancy
	Quality-adjusted life years
The side effects or drawbacks to the intervention you are considering	False-positive results of a PSA with increasing age
	Bleeding complications from aspirin use
The cost of the intervention	Insurance coverage
	Out-of-pocket costs
	Cost per QALY
The logistics of the intervention	Colonoscopy preparation for frail patients
Patient goals versus provider goals	Pain reduction
Shared decision-making	Increased survival
	Quality of life

Furthermore, the phenotype for the older adult greater than 65 years is varied. When deciding which preventive measures to recommend, a variety of considerations require attention (Table 3.3) including the natural history of the disease being prevented; the impact of the disease in terms of both mortality and morbidity if it is not prevented, detected, or treated; the potential risks and costs of the interventions being considered; and most importantly the patient's goals and wishes regarding their health. The ability of healthcare providers to understand the terms used to describe the effect and significance of health promotion and disease prevention data is important. Geriatricians at Saint Louis University have created a "Clinical Glidepath" as an outpatient tool to guide health maintenance decision-making (Table 3.4) [6]. This tool helps guide healthcare providers to choose a prevention strategy for the "oldest old" by taking into consideration the patient's life expectancy and physical and cognitive function.

Prevention is frequently categorized as primary, secondary, or tertiary. These levels of prevention have been well described by Leavell and Clark and are known as "Leavell's levels." Primary prevention refers to preventing the occurrence of a disease or disability. For a patient with no known risk factors, we may emphasize general health promotion such as exercise or a healthy diet. For patients who are susceptible to specific disease, we may recommend specific interventions, such as immunizations or smoking cessation. Secondary prevention refers to the early identification of asymptomatic disease and includes screening measures such as mammograms and colonoscopies to identify patients with early breast cancer and colon cancer, respectively. Finally, tertiary prevention includes symptomatic disease management, for example: helping patients with diabetes mellitus lower their blood sugars as a means of preventing future visual impairment; or, rehabilitation which allows a patient with a recent stroke to recover limb function and become more independent in their activities of daily living [7]. Clinicians spend the majority of their time with patients concentrating on the management of existing disease and disability. Their goal is to improve patient outcomes, and most of this work would fall under the definition of tertiary prevention. Historically, discussions of disease prevention have concentrated on primary and secondary prevention, but for older patients who often have existing diseases and disabilities, tertiary prevention becomes increasingly important.

Clinicians rely on statistical evidence to guide decision-making. Sensitivity is the ability of a test to detect a disease when the disease is present. Specificity is the ability of a test to predict when a disease is absent. Predictive values contextualize test results based on the prevalence of disease. The positive predictive value indicates the proportion of those with a positive test who have disease. The negative predictive value indicates the proportion of those with a negative test who do not have disease [7]. Absolute risk of a disease is the risk of developing the disease over a time period. Relative risk is used to compare the risk in two different groups of people.

A critical review of research literature should guide our approach to disease and disability prevention. When interpreting study results, the impact of risk is an important consideration. Higher level studies such as cohort or randomized controlled trials allow the calculation of absolute and relative risk, whereas observational studies allow only for the determination of relative risk. The absolute differences in risk are also known as attributable risk, or the amount of risk caused by a risk factor. For example, this might be considered when deciding to screen for lung cancer. Relative risk, or risk ratio, is the ratio of risk in the

Table 3.4 The Health Maintenance Clinical Glidepath [6]

Procedure	Robust elderly Life expectancy ≥5 years and functionally independent	Frail Life expectance <5 years or significant functional impairment	Moderately demented Life expectancy 2 to 10 years	End of life Life expectancy <2 years
Office visits	Do once a year	Do 1–4 times/year	Do 1–4 times/year	Do as needed
Blood pressure including orthostatics	Do each visit	Do each visit	Do each visit	Do each visit
Weight	Do each visit. If loss of >5 lbs/year, perform Mini Nutritional Assessment	Do each visit. If loss of >5 lbs/year, perform Mini Nutritional Assessment	Do each visit. If loss of >5 lbs/year, perform Mini Nutritional Assessment	Don't do
Height	Do once a year	Do once a year	Don't do	Don't do
Cholesterol screening	Consider screening for patients aged 65–75 if additional risk factors (e.g., smoking, diabetes mellitus, hypertension)	Consider screening for patients aged 65–75 if additional risk factors (e.g., smoking, diabetes mellitus, hypertension)	Don't do	Don't do
Breast examination	Do yearly	Do yearly	Do yearly	Don't do
Mammography	Do every 1–2 years up to age 80	Consider every 1–2 years up to age 75	Consider every 1–2 years up to age 70	Don't do
Papanicolaou (Pap) smear	Consider 1–3 Pap smears if patient has never had	Don't do	Don't do	Don't do
Prostate-specific antigen	Discuss pros and cons with patient	Discuss pros and cons with patient	Discuss pros and cons with caregiver	Don't do
Fecal occult blood test	Do yearly	Consider yearly	Consider yearly	Don't do
Colonoscopy	Consider every 5 years	Don't do	Don't do	Don't do
Influenza vaccine	Do yearly	Do yearly	Do yearly	Do yearly
Pneumococcal vaccine	Do once; consider repeat every 6 years for patients with chronic disease	Do once	Do once	Consider vaccination once
Tetanus	Do primary series if not vaccinated before and booster every 10 years	Do primary series if not vaccinated before	Do primary series of not vaccinated before	Don't do
Thyroid-stimulating hormone	Do every 2 years	Do every 2 years	Do every 3 years	Consider
Lifestyle education (exercise, smoking cessation, alcohol, and injury prevention)	Do every visit	Do every visit	Discuss periodically with caregiver	Don't do
Aspirin	Do, if history of myocardial infarction or ≥2 cardiovascular risk factors	Do, if history of myocardial infarction or ≥2 cardiovascular risk factors	Do, if history of myocardial infarction or ≥2 cardiovascular risk factors	Don't do
Ask about erectile dysfunction and androgen deficiency in aging males and screen for hypogonadism	Do yearly	Do yearly	Consider yearly	Don't do
Visual acuity testing	Consider every year	Consider every year	Consider every year	Don't do
Hearing impairment	Consider every year	Consider every year	Consider every year	Don't do
Ask about urinary incontinence	Do yearly	Do yearly	Do yearly	Do yearly
Maintain awareness of elder abuse	Do each visit	Do each visit	Do each visit	Do each visit
Asses ADLs and IADLs	Do yearly	Do each visit	Do each visit	Do each visit
Fasting blood glucose	Do, if symptomatic or 3 years if has risk factors	Do, if symptomatic or 3 years if has risk factors	Do, if symptomatic or 3 years if has risk factors	Consider if symptomatic
Cognitive screening	Do initially; do if symptomatic	Do initially; do if symptomatic	Do initially	Consider if symptomatic
Depression screening	Do initially; do if symptomatic	Do initially; do if symptomatic	Do initially; do if symptomatic	Do initially; do if symptomatic