

U.S. Army War College

Maximizing Senior Leader Health and Wellbeing



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MAXIMIZING SENIOR LEADER HEALTH AND WELLBEING

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Cover design by Jennifer Nevil and the editors. Some of the graphic elements used in the cover design were paid for through <https://www.shutterstock.com>. The editors thank Jennifer Nevil for her attention to detail and expertise in publishing this text.

ISBN: 1-58487-842-8

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Chapter 2

PHYSIOLOGICAL CHANGES IN MIDLIFE

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...intelligence and skill can only function at the peak of their capacity when the body is healthy and strong...hardy spirits and tough minds usually inhabit sound bodies.

John F. Kennedy¹

In Chapter 1, Hosie, Meredith, and Almeida defined the concept of midlife as the period between the ages of forty and sixty-five. This midlife period is when most senior leaders tend to move into more mentally demanding positions and, as a result, become increasingly sedentary while working longer hours. Unfortunately, changes in work and family environments commonly experienced in midlife can exacerbate physiological challenges and decline.² Since senior leaders hold critical billets within their respective services, they should adopt health and wellbeing practices to maximize their performance in support of the success of their units, agencies, and/or staffs.

Senior leader health and wellness is a strategic issue that impacts leader availability and productivity. Unfortunately, health and wellness indicators are declining across the force. According to the Centers for Disease

1. John F. Kennedy, "The Soft American," *Sports Illustrated*, December 26, 1960, 15-17, <https://vault.si.com/vault/1960/12/26/43278#&gid=ci0258c07fc00526ef&pid=43278---017---image>.

2. Lynn F. Cherkas et al., "The Association Between Physical Activity in Leisure Time and Leukocyte Telomere Length," *Journal of the American Medical Association Internal Medicine* 168, no. 2 (January 28, 2008): 154-58, <https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/413815>.

Control, the Department of Defense spends about \$1.5 billion per year in obesity-related health care costs, with obese service members 33% more likely to experience musculoskeletal injuries. Overweight and obesity statistics increased among service members from 2011 to 2015 by 73%, and lost workdays related to these conditions cost the Department of Defense \$103 million a year.³ The incidence of heart disease, the leading cause of death in the United States, increased significantly in soldiers from 6.8% to 9.4% between 2007 to 2014.⁴ Contrary to expectations, the study found that active-duty troops had higher blood pressure than like-aged civilian counterparts. This troubling trend was also seen in the US Army War College (USAWC) student population. Fortunately, research suggests that wellness programs can be part of a solution, potentially increasing productivity and reducing absenteeism.⁵

The USAWC Senior Leader Sustainment Program provides resident students at Carlisle Barracks a holistic health and fitness assessment that includes bloodwork, body composition, strength, cardiovascular health, and diet. Participants receive personalized lifestyle recommendations and, if necessary, medical intervention.⁶ The average participant in Academic Year 2021 was 45 years old, squarely in midlife.⁷ Although the average participant had a 23.6% body fat, approximately 15% of them had a body fat percentage greater than 30% and 20% had a body mass index over 30, placing them at high risk for health issues.⁸ Similarly, the average total cholesterol level was 196.6 mg/dL, but 46% of the participants had high total cholesterol levels (over 200 mg/dL).⁹ Moreover, 30% of the participants had high low-density lipoprotein cholesterol levels (over 130 mg/

3. National Center for Chronic Disease Prevention and Health Promotion, "Chronic Diseases and Military Readiness," Chronic Disease Fact Sheets, Centers for Disease Control, last reviewed August 10, 2022, <https://www.cdc.gov/chronicdisease/resources/publications/factsheets/military-readiness.htm>.

4. "Army Troops Have Worse Heart Health than Civilian Population, Study Says," American Heart Association, June 5, 2019, . <https://www.heart.org/en/news/2019/06/05/army-troops-have-worse-heart-health-than-civilian-population-study-says>.

5. Jeffrey Hayzlett, "Do Wellness Programs Make Employees More Productive? The Obvious Answer Is Yes," Entrepreneur, March 2, 2018, <https://www.entrepreneur.com/article/309685>.

6. Robert Martin, "Senior Leader Sustainment Program - A Priority for the Army War College," News, U.S. Army War College, August 23, 2019, <https://www.armywarcollege.edu/news/article/1476>.

7. U.S. Army War College 2021 Senior Leader Sustainment Program, personal communication with David Hughes, 2021.

8. National Heart, Lung, and Blood Institute, "BMI Tools," National Institutes of Health, accessed on April 5, 2021, https://www.nhlbi.nih.gov/health/educational/lose_wt/bmitools.htm.

9. Rena Goldman, "The Recommended Cholesterol Levels by Age," Healthline, last updated August 24, 2021, <https://www.healthline.com/health/high-cholesterol/levels-by-age>.

dL), 8% had low high-density lipoprotein levels (less than 40 mg/dL), and 12.8% had high blood glucose levels (over 100 mg/dL).¹⁰ Finally, approximately 70% of the participants were categorized as having higher than normal blood pressure (over 120/80 mm Hg) according to the American Heart Association standards.¹¹ When considered as a whole, these numbers stress the importance of making critical lifestyle choices to reverse these warning signs and slow the physiological changes that occur during midlife, particularly in individuals facing the additional challenges associated with aging and senior leadership.

Aging is affected by both biological and environmental factors. Primary aging, or the age-related changes influenced by genetics, is less malleable than secondary aging, or age-related changes associated with lifestyle choices (e.g., physical activity levels and dietary choices).¹² Many adults in midlife misattribute their physical condition to primary aging and underestimate the role their own decisions play in the aging process.¹³ Several research studies, particularly those that followed twins across their lifespan, attribute 25% of longevity to heredity.¹⁴ Thus, environmental factors and lifestyle choices play a far more significant role in determining longevity and the resulting quality of life than people realize. That means senior leaders have the power to influence the aging process. By controlling the factors within their control, senior leaders can remain physically fit and avoid many of the unpleasant changes associated with secondary aging while mitigating the biological changes that lead to frailty later in life.¹⁵

As senior leaders age, their bodies' resources are taxed more to remain at rest (homeostasis) and have fewer resources available when needed to respond to challenges (a phenomenon called homeostenosis).¹⁶ The aging

10. Mayo Clinic Staff, "Diabetes," Diseases & Conditions, Mayo Clinic, last updated October 30, 2020, <https://www.mayoclinic.org/diseases-conditions/diabetes/diagnosis-treatment/drc-20371451>.

11. American Heart Association Editorial Staff, "Understanding Blood Pressure Reading," American Heart Association, accessed April 5, 2021, <https://www.heart.org/en/health-topics/high-blood-pressure/understanding-blood-pressure-readings>.

12. Ewald Busse and Eric Pfeiffer, "Theories of Aging," in *Behavior and Adaptation in Late Life* (Boston: Little, Brown and Company, 1969), 11-31.

13. Martha Lally and Suzanne Valentine-French, "8.1: Physical Development in Middle Adulthood" in *Lifespan Development: A Psychological Perspective* (The University of California, CA: Libre Texts, 2019), accessed on December 10, 2020, [https://socialsci.libretexts.org/Bookshelves/Human_Development/Book%3A_Lifespan_Development_-_A_Psychological_Perspective_\(Lally_and_Valentine-French\)/08%3A_Middle_Adulthood/8.01%3A_Physical_Development_in_Middle_Adulthood](https://socialsci.libretexts.org/Bookshelves/Human_Development/Book%3A_Lifespan_Development_-_A_Psychological_Perspective_(Lally_and_Valentine-French)/08%3A_Middle_Adulthood/8.01%3A_Physical_Development_in_Middle_Adulthood).

14. Giuseppe Passarino, Francesco De Rango, and Alberto Montesanto, "Human Longevity: Genetics or Lifestyle? It Takes Two to Tango," *Immunity & Ageing* 13, no. 12 (2016), <https://doi.org/10.1186/s12979-016-0066-z>.

15. Lally and Valentine-French, "8.1: Physical Development."

16. George Taffet, "Normal Aging," UpToDate, last updated April 19, 2019, <https://www.uptodate.com/contents/normal-aging>; The diminishing reserves are observed in decreased responsiveness in heart rate variability, blood pressure, and stress response to stimuli.

body's inability to respond to stressors increases disease and injury risk and culminates in frailty, where even the most minor challenges can overwhelm available resources.¹⁷ Despite this decline, senior athletes maintain more significant heart rate variability and exercise capacity than their sedentary counterparts, demonstrating that lifestyle choices can affect the rate of degeneration towards homeostasis.¹⁸ The following sections examine the effects of aging on different physiological systems and how lifestyle choices can affect them.

The Musculoskeletal System

The musculoskeletal system is comprised of the bones, muscles, tendons, ligaments, joints, cartilage, and other connective tissues that provide form, support, stability, and movement to the body.¹⁹ This section focuses on muscle and bone, both of which experience age-related decline significantly responsive to lifestyle choices. Frailty later in life is characterized by significant loss of muscle mass, strength, and changes in muscle composition. Sarcopenia, the age-related loss of lean muscle mass, is accompanied by a loss in power, progresses non-linearly, accelerating with advanced age.²⁰

Numerous factors contribute to sarcopenia, making it difficult to determine the specific rate of decline. For example, muscles are highly dependent upon the cardiovascular and nervous systems to function.²¹ Moreover, changes in basal metabolic rate, body composition, insulin resistance, hormone levels, and physical activity levels can also contribute to sarcopenia. On average, men lose 0.47% of their muscle mass per year beginning in their thirties, whereas women lose 0.37% of their muscle mass per year beginning in their thirties.²² This loss of mass translates to approximately

17. Taffet, "Normal Aging."

18. F. Galetta, et al., "Lifelong Physical Training Prevents the Age-Related Impairment of Heart Rate Variability and Exercise Capacity in Elderly People," *Journal of Sports Medicine and Physical Fitness* 45, no. 2 (June 2005): 217-21, <https://pubmed.ncbi.nlm.nih.gov/16355084/>.

19. Alexandra Villa-Forte, "Introduction to the Biology of the Musculoskeletal System" in *Bones, Joint, and Muscle Disorders*, Merck Manuals Consumer Version (Rahway, NJ: Merck & Co., December 2019), <https://www.merckmanuals.com/home/bone-joint-and-muscle-disorders/biology-of-the-musculoskeletal-system/introduction-to-the-biology-of-the-musculoskeletal-system>.

20. Patrick Siparsky, Donald Kirkendall, and William Garrett, "Muscle Changes in Aging: Understanding Sarcopenia," *Sports Health* 6, no. 2, (Jan/Feb 2014): 36-40, <https://doi.org/10.1177/1941738113502296>.

21. Timothy Doherty, "Invited Review: Aging and Sarcopenia," *Journal of Applied Physiology* 95 (2003):1717-19, <https://doi.org/10.1152/jappphysiol.00347.2003>.

22. W. Kyle Mitchell et al., "Sarcopenia, Dynapenia, and the Impact of Advancing Age on Human Skeletal Muscle Size and Strength: A Quantitative Review," *Frontiers in Physiology* 3, no. 260 (July 11, 2012), <https://www.frontiersin.org/articles/10.3389/fphys.2012.00260/full>.

one-half pound of muscle per year from thirty to sixty years while simultaneously gaining a pound of fat per year.²³ Coincidentally, men lose 3-4% of their muscular strength per year, and women lose 2.5-3% of their muscular strength per year.²⁴ Sarcopenia is most dramatic and observable in later adulthood, particularly the seventh decade. In contrast, the slower rate of decline before and during midlife may not affect daily activities and may only be apparent under significant stress.²⁵

Nevertheless, healthy lifestyle choices during midlife reduce functional impairment later in life, reinforcing the importance of lifestyle choices.²⁶ Sedentary individuals lose muscle mass and corresponding strength at higher rates than physically active individuals. For example, immobilized patients and patients on bed rest lost substantial skeletal muscle mass and between 0.3% and 4.2% muscle strength per day.²⁷

Age-related decreases in muscle mass and strength also coincide with changes in muscle composition. Type I muscle fibers, or slow-twitch muscles, are associated with muscular endurance. The number of type I muscle cells remains relatively static throughout adulthood and decreases in volume by 25% or less throughout the lifespan.²⁸ The relatively fixed number of type I cells explains, in part, how older athletes can continue to compete in endurance events, often setting personal bests during midlife.²⁹

On the other hand, type II muscle fibers, or fast-twitch muscles associated with peak strength and explosive power, decline significantly with age.³⁰ The number and size of type II muscle fibers peak before the age of

23. Taylor J. Marcell, "Sarcopenia: Causes, Consequences, and Preventions," *The Journals of Gerontology Series A* 58, no. 10 (October 2003), M911-M916, <https://doi.org/10.1093/gerona/58.10.M911>.

24. Mitchell et al., "Sarcopenia."

25. Richard G. Stefanacci, "Physical Changes with Aging" (Rahway, NJ: Merck & Co., December 2019), Merck Manual Professional Version, last modified September 2022, <https://www.merckmanuals.com/professional/geriatrics/approach-to-the-geriatric-patient/physical-changes-with-aging#v1130874>.

26. Stefanacci, "Physical Changes with Aging."

27. Michael Tieland, Inez Trouwborst, and Brian C. Clark, "Skeletal Muscle Performance and Aging," *Journal of Cachexia, Sarcopenia and Muscle* 9, no. 1 (November 19, 2017): 3-19, <https://doi.org.usawc.idm.oclc.org/10.1002/jcsm.12238>.

28. Doherty, "Invited Review," 1721.

29. Ben Opipari, "Even in Middle Age, Your Best Running Days May Still be Ahead of You," *Wellness, The Washington Post Online* (March 8, 2017), https://www.washingtonpost.com/lifestyle/wellness/even-in-middle-age-your-best-running-days-may-still-be-ahead-of-you/2017/03/07/5bf54696-fddc-11e6-99b4-9e613afeb09f_story.html.

30. Pete McCall, "Muscle Fiber Types: Fast-Twitch vs. Slow-Twitch," *Exercise Science, American Council on Exercise*, October 30, 2015, <https://www.acefitness.org/education-and-resources/professional/expert-articles/5714/muscle-fiber-types-fast-twitch-vs-slow-twitch/>.

thirty and gradually decrease after that.³¹ The age-related decline in type II muscle fibers plays a significant role in strength loss and is evident in the National Football League and the National Basketball Association players. Both sports require significant explosive power and bursts of speed, and, in both cases, the average age of players is twenty-six years old.³² The average age of National Football League and the National Basketball Association players mirrors the decline in fast-twitch muscles that begins around thirty and demonstrates the relationship between fast-twitch muscle fibers and age-related losses in general muscle strength.³³

Although the average age in the National Football League demonstrates the impacts of aging, several players seem to defy the effects of aging. Max Kellerman, a commentator on ESPN's *First Take*, famously stated in 2016 that quarterback Tom Brady would fall off a cliff and become a bum in short order.³⁴ Since that time, Brady appeared in four Super Bowls, winning three (including one with a new team), was Super Bowl Most Valuable Player twice, and was the League Most Valuable Player once.³⁵ Kellerman failed to appreciate how Brady's lifestyle choices, from his TB12 workout methods to his diet, have allowed him to continue to play at a high level.³⁶ Although senior military leaders may not be playing professional football, they can still realize benefits from healthy lifestyle choices throughout adulthood. For example, men over the age of sixty-six who trained at 80% of their one-repetition maximum achieved gains in strength similar to improvements seen in much younger men. Moreover, adults over the age of ninety also improved their strength, resulting in higher levels of mobility.³⁷ Studies such as these suggest that lifelong exercise allows men and women to maintain their strength and endurance longer across their lifespans.

31. Stefanacci, "Physical Changes with Aging."

32. Khari Arnold, "Nine Takeaways from 2018-2019 NBA Roster Survey," News, National Basketball Association, October 24, 2018, <https://www.nba.com/news/takeaways-2018-19-nba-roster-survey>; ESPN Stats & Info, "Average Age in Esports Vs. Major Sports," Esports, ESPN, September 17, 2017, https://www.espn.com/esports/story/_/id/20733853/the-average-age-esports-versus-nfl-nba-mlb-nhl.

33. Siparsky, Kirkendall, and Garrett, "Muscle Changes in Aging," 38.

34. *First Take*, "The Best of Max Kellerman's Tom Brady 'Cliff Theory,'" aired on January 19, 2020, on ESPN, YouTube video file, 07:59, <https://www.youtube.com/watch?v=RvyAVctVB5I&t=556s>.

35. Nick Goss, "ESPN's Max Kellerman Roasts Himself With Awesome Tom Brady 'Cliff' Tweet," Sports, News, NBC Boston, January 24, 2021, updated January 24, 2021, <https://www.nbcboston.com/news/sports/nbcsports/espn-max-kellerman-roasts-himself-with-awesome-tom-brady-cliff-tweet/2286003>.

36. Scott Davis, "Tom Brady Is Still Dominating in His 40s Thanks to a Strict Fitness and Nutrition Lifestyle He Calls 'The TB12 Method,'" Sports, *Insider Online*, updated March 23, 2020, <https://www.businessinsider.com/the-tb12-method-how-tom-brady-trains-to-stay-at-the-top-of-his-game-2017-12>.

37. Siparsky, Kirkendall, and Garrett, "Muscle Changes in Aging," 38.

Like muscle development, we can influence bone development across the lifespan. Skeletal bones provide the body's structure, support body weight, protect vital organs, store minerals, produce blood cells, and work with muscles to enable movement. The skeletal system consists of 206 bones, cartilage, joints, ligaments, and tendons.³⁸ Bone composition, approximately 65% inorganic (mainly calcium phosphate) and 35% organic (primarily collagen), affects bone growth and health.

Across the lifespan, bones undergo a process of generation, regeneration, and decline. Bones grow in length until a point late in adolescence when the growth plates close.³⁹ From this point, the bones continue a process known as remodeling, the resorption of old bone and deposition of new bone, bringing bone density to a peak before age thirty, and ultimately replacing the skeleton approximately every ten years.⁴⁰ The remodeling process involves the interaction of two cell types, osteoclasts and osteoblasts, that interact with hormones, minerals, growth factors, and environmental factors.⁴¹

Hormones, particularly testosterone and estrogen, play a significant role in controlling remodeling. The decrease in estrogen, for example, causes a greater rate of resorption over deposition, making low bone density particularly concerning for post-menopausal women.⁴² For example, osteoporosis is a disease commonly seen in women that develops as bone mineral density and mass decline, increasing fracture risk. Osteoporosis often becomes evident only after a fracture, as symptoms may not be present.⁴³ Osteoporosis occurs when the bone mineral density levels fall at least 2.5 standard deviations below the levels seen in young adults. Osteopenia exists when bone mineral density levels drop between 1 - 2.5 standard

38. "Skeletal System," Health Library, Cleveland Clinic, last reviewed November 19, 2019, accessed February 6, 2021, <https://my.clevelandclinic.org/health/articles/21048-skeletal-system>.

39. Frank Pessler, "Overview of Bone Disorders in Children" in *Bone Disorders in Children*, Merck Manual Consumer Version (Rahway, NJ: Merck & Co., December 2019), last modified November 2022, <https://www.merckmanuals.com/home/children-s-health-issues/bone-disorders-in-children/overview-of-bone-disorders-in-children#v38720668>.

40. Alexandra Villa-Forte, "Bones," in *Bones, Joint, and Muscle Disorders*, Merck Manuals Consumer Version (Rahway, NJ: Merck & Co., December 2019), last modified September 2022, <https://www.merckmanuals.com/home/bone,-joint,-and-muscle-disorders/biology-of-the-musculoskeletal-system/bones>.

41. George K. Chan and Gustavo Duque, "Age-Related Bone Loss: Old Bone, New Facts," *Gerontology* 48, no. 2 (March/April 2002), 62-63, <https://doi.org/10.1159/000048929>.

42. Chan and Duque, "Age-Related Bone Loss," 64.

43. NIH Osteoporosis and Related Bone Diseases National Resource Center, "Osteoporosis Overview," National Institute of Arthritis and Musculoskeletal and Skin Diseases, National Institutes of Health, last reviewed October 2019, <https://www.bones.nih.gov/health-info/bone/osteoporosis/overview>.

deviations below normal levels and is considered a precursor to osteoporosis.⁴⁴ Hormone replacement therapy may help post-menopausal women retain bone mineral density, but it carries significant risks that will be discussed later.⁴⁵

Although most osteoporosis studies have focused on older adult populations, low bone density is becoming a concern for adults in midlife.⁴⁶ In a recent study, more than a quarter of the men and women between thirty-five and fifty years old had osteopenia, leading to osteoporosis in later life.⁴⁷ Moreover, the number of fat-storing cells (adipose tissue) deposited within the bone marrow also increased with age.⁴⁸ Higher levels of bone marrow fat and lower bone density correlate with a higher incidence of fractures, but the exact causal relations are still under investigation.⁴⁹ These findings are concerning, but the lifestyle choices described below can help maintain skeletal health.

The lifestyle choice that most directly impacts skeletal health is the decision to engage in weight-bearing exercises such as weightlifting, hiking, walking, and climbing stairs.⁵⁰ Sustaining high levels of weight-bearing training also increases bone mineral density, strength, balance, and coordination, all of which lower fall risk and instances of bone fracture later in life.⁵¹

Besides performing weight-bearing exercises, senior leaders should meet the recommended daily intake of calcium and vitamin D to support healthy bone mass. Calcium is readily available in dairy products, fatty

44. World Health Organization Scientific Group, *The Assessment of Osteoporosis at Primary Health Care Level*, Summary Report PDF (Geneva: WHO Collaborating Centre for Metabolic Bone Diseases, 2007), 2, https://frax.shef.ac.uk/FRAX/pdfs/WHO_Technical_Report.pdf.

45. Martha Lally and Suzanne Valentine-French, "8.5: Climacteric" in *Lifespan Development: A Psychological Perspective* (The California State University, CA: Libre Texts, 2019), accessed on December 10, 2020, [https://socialsci.libretexts.org/Bookshelves/Human_Development/Book%3A_Lifespan_Development_-_A_Psychological_Perspective_\(Lally_and_Valentine-French\)/08%3A_Middle_Adulthood/8.05%3A_Climacteric](https://socialsci.libretexts.org/Bookshelves/Human_Development/Book%3A_Lifespan_Development_-_A_Psychological_Perspective_(Lally_and_Valentine-French)/08%3A_Middle_Adulthood/8.05%3A_Climacteric).

46. Martha A. Bass et al., "Bone Mineral Density Among Men and Women Aged 35 to 50 Years," *Journal of American Osteopathic Association* 119, no. 6 (June 2019), 358, <https://jaoa.org/article.aspx?articleid=2735169>.

47. Bass et al., "Bone Mineral Density," 357.

48. Taffet, "Normal Aging."

49. Xiaojuan Li and Ann Schwartz, "MRI Assessment of Bone Marrow Composition in Osteoporosis," *Current Osteoporosis Reports* 18, no. 1 (February 2020): 57-66, <https://doi.org/10.1007/s11914-020-00562-x>.

50. Villa-Forte, "Introduction to the Biology."

51. Karl Michaelsson et al., "Leisure Physical Activity and the Risk of Fracture in Men," *PLOS Medicine* 4, no. 6 (June 19, 2007), <https://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.0040199>.

fish, almonds, sesame seeds, and many green leafy vegetables.⁵² The body also produces vitamin D, which aids in calcium absorption when cholesterol in the skin is converted into vitamin D after exposure to ultraviolet radiation.⁵³ Although several factors (i.e., geographic location and skin tone) affect how quickly the body begins converting vitamin D, as little as 15 minutes a day may be sufficient. Levels can also be augmented by eating vitamin D-rich foods such as milk and cereal, fatty fish (i.e., salmon and tuna), mushrooms, and egg yolks.⁵⁴ Doctors may also recommend a supplement if your vitamin D levels are low.

The Neurocognitive System

The neurocognitive system includes the structures and processes in the central nervous system that regulate cognitive function.⁵⁵ The brain receives inputs from the various senses, processes them, and controls the body's response. The brain is composed of grey matter (primarily neurons) and white matter (primarily axons that connect nerve cells). Axons are covered in a fatty substance called myelin that gives them their white appearance.⁵⁶ Both grey and white matter play a role in neurocognitive health.

Cognitive abilities continue to increase into the fifties but begin to decline as the volume of white matter begins to fall.⁵⁷ For example, longitudinal studies using a battery of cognitive tests revealed cognitive function improves well into midlife.⁵⁸ These findings also illustrate the difference between fluid and crystallized intelligence. Fluid intelligence is the capacity to learn new ways of solving problems and performing activities quickly and abstractly. Crystallized intelligence is the accumulated knowledge of the world acquired through formal learning and experience. Both crystallized and fluid intelligence tend to increase through early adulthood but then begin to diverge as fluid intelligence begins to decline.⁵⁹ Although

52. Marcy B. Bolster, "Osteoporosis" in *Bones, Joint, and Muscle Disorders*, Merck Manuals Consumer Version (Rahway, NJ: Merck & Co., December 2019), last modified September 2022, <https://www.merckmanuals.com/home/bone,-joint,-and-muscle-disorders/osteoporosis/osteoporosis#v28546768>.

53. Ansley Hill, "7 Effective Ways to Increase Your Vitamin D Levels," Healthline, March 17, 2019, last reviewed May 5, 2022, <https://www.healthline.com/nutrition/how-to-increase-vitamin-d>.

54. Hill, "7 Effective Ways."

55. "Neurocognitive," Medical, Merriam-Webster, accessed February 7, 2021, <https://www.merriam-webster.com/medical/neurocognitive>.

56. Esther Heerema, "White Matter in the Brain," Verywell Health, last updated April 15, 2022, <https://www.verywellhealth.com/what-is-white-matter-in-the-brain-98119>.

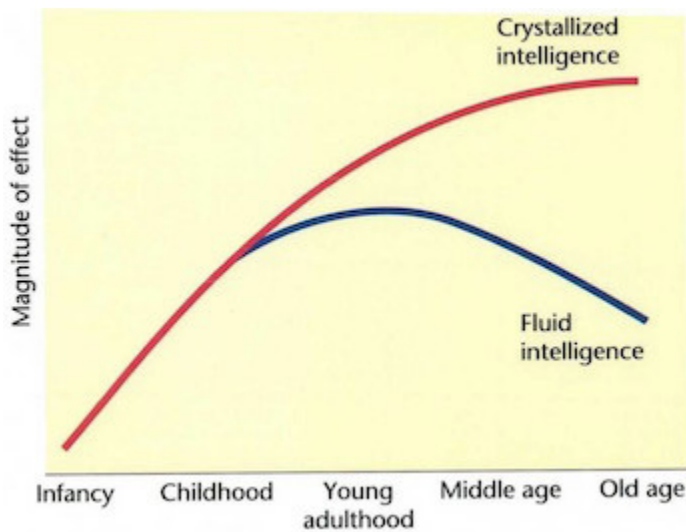
57. Melissa Lee Phillips, "The Mind at Midlife," *Monitor on Psychology* 42, no. 4 (April 2011), <https://www.apa.org/monitor/2011/04/mind-midlife>.

58. Phillips, "The Mind at Midlife."

59. Martha Lally and Suzanne Valentine-French, "8.6: Brain Functioning" in *Lifespan Development: A Psychological Perspective* (The University of California, CA: Libre Texts, 2019), accessed on December 10, 2020, <https://opentextbooks.concordia.ca/lifespandevelopment/chapter/8-6-brain-functioning/>.

an older adult may not think as quickly as a younger adult, they have a broader base to draw from, allowing them to achieve better outcomes.⁶⁰ For example, a younger chess player may decide on moves faster, but older players tend to win by drawing on years of experience. Even when presented with a seemingly novel situation, the midlife adult is likely to have faced a similar problem and have a potential solution.⁶¹ Moreover, adults in midlife tend to be calmer and better able to navigate social situations than younger adults.⁶² Retaining cognitive function is one of the more positive aspects of aging in midlife, but several lifestyle choices can help sustain cognitive health across the lifespan.⁶³

Figure 2. Crystallized and Fluid Intelligence.⁶⁴



Countless software developers claim that their smartphone applications can help improve cognition. However, researchers at Cedars-Sinai suggest that developing neuroplasticity, or the brain's ability to rewire itself, is

60. Phillips, "The Mind at Midlife."

61. Martha Lally and Suzanne Valentine-French, "8.8: Gaining Expertise - The Novice and the Expert" in *Lifespan Development: A Psychological Perspective* (The University of California, CA: Libre Texts, 2019), accessed on December 10, 2020, [https://socialsci.libretexts.org/Bookshelves/Human_Development/Book%3A_Lifespan_Development_-_A_Psychological_Perspective_\(Lally_and_Valentine-French\)/08%3A_Middle_Adulthood/8.08%3A_Gaining_Expertise_-_The_Novice_and_the_Expert](https://socialsci.libretexts.org/Bookshelves/Human_Development/Book%3A_Lifespan_Development_-_A_Psychological_Perspective_(Lally_and_Valentine-French)/08%3A_Middle_Adulthood/8.08%3A_Gaining_Expertise_-_The_Novice_and_the_Expert).

62. Phillips, "The Mind at Midlife."

63. Lisa Ronan et al., "Obesity Associated with Increased Brain Age from Midlife," *Neurobiology of Aging* 47 (2016): 63-70, <https://doi.org/10.1016/j.neurobiolaging.2016.07.010>.

64. Sarah Bryant, "Working Memory Training," Study.com, September 11, 2017, <https://study.com/academy/lesson/working-memory-training.html>.

more complicated than simply repeating the same tasks.⁶⁵ Optimally, the brain needs to be challenged continuously with new trials while being supported by an overall healthy lifestyle. In other words, eating a healthy diet consisting of whole foods, getting adequate sleep, not smoking, limiting alcohol consumption, and getting regular exercise benefits both the heart and the brain.⁶⁶

Maintaining a healthy lifestyle may also support the brain in another surprising way. A recent study measured white matter volume in individuals categorized by body mass index. As expected, white matter increased through middle age and decreased after that. For overweight and obese subjects, however, white matter volume decreased more rapidly than in lean subjects. Overweight or obese participants exhibited accelerated brain age by a decade compared to the lean subjects in midlife, suggesting that cardiovascular fitness can protect and restore white matter and short-term memory.⁶⁷

The Cardiopulmonary System

The cardiopulmonary system is composed of two distinct but interrelated systems. The cardiovascular system includes the heart, blood vessels, and blood that work together to transport oxygen, nutrients, hormones, and waste, fight infection, clot bleeding in wounds, and support thermoregulation.⁶⁸ The collection of airways, lungs, muscles, and blood vessels that allow us to breathe make up the respiratory system. While its primary function is to exchange oxygen and carbon dioxide, the respiratory system also allows us to talk and smell. The musculoskeletal system provides the structure and muscular function that facilitates breathing, while the respiratory system provides the oxygen that fuels the muscles.⁶⁹

Senior leaders must focus on their cardiopulmonary health in midlife. According to the Centers for Disease Control and Prevention, heart disease and cancer are the leading causes of death in midlife. Improvements in detecting and treating cancer have led to a steady decline in cancer deaths from 1999 to 2017. Although total deaths from heart disease also decreased,

65. Kyle Beswick, "Do Brain Games Help Brain Health?" Cedars-Sinai, Cedars-Sinai (blog), September 23, 2019, <https://www.cedars-sinai.org/blog/brain-games.html>.

66. "The Thinking on Brain Games," Harvard Health Publishing, Harvard Medical School, October 1, 2019, <https://www.health.harvard.edu/mind-and-mood/the-thinking-on-brain-games>.

67. Ronan et al., "Obesity," 63-70.

68. Healthline Editorial Team, "Circulatory," Human Body Maps, Healthline, last updated December 31, 2021, <https://www.healthline.com/human-body-maps/circulatory-system#1>.

69. "Respiratory System," Health Library, Cleveland Clinic, last reviewed January 24, 2020, <https://my.clevelandclinic.org/health/articles/21205-respiratory-system>

researchers noticed a troubling increase in deaths in subjects between 44 and 64 years old during the last three years of the study.⁷⁰ These years coincide with periods of increased stress associated with senior leadership.

In a recent study, the Defense Health Agency found that 18.1% of active-duty service members had at least one of the risk factors associated with cardiovascular disease - obesity, high cholesterol, high blood pressure, or elevated blood glucose levels. The incidence rates increased progressively with advancing age, mirroring the findings seen in the USAWC student population (see page 2).⁷¹ In addition, senior leaders are more likely to have experienced deployments, further increasing their risk for heart disease.⁷²

Maximum oxygen utilization ($VO_{2\max}^2$), or the cardiopulmonary system's maximum workload, also decreases throughout midlife and beyond. The traditional formula for estimating maximum heart rate ($220 - \text{age}$) highlights aging's impact on the heart's ability to work.⁷³ Other procedures used to calculate the maximum aerobic heart rate, where the exertion level is nearly all aerobic, also use age in the computation.⁷⁴ Whether using a formula to estimate maximum heart rate or maximum aerobic heart rate, work capacity diminishes with age. Although physical exercise can improve aerobic capacity in sedentary individuals, physical training does not modify the age-related decline in maximum heart rate.⁷⁵ Studies have indicated that the rate of decrease in aerobic capacity coming into and through midlife begins at 3-6% per decade but accelerates to 20% per decade beyond age seventy.⁷⁶ The rapid degradation in the ability to use oxygen across the lifespan underscores the need to sustain aerobic fitness in midlife as a critical component of well-being later in life.

70. Sally C. Curtin, "Trends in Cancer and Heart Disease Death Rates Among Adults Aged 45-64: United States, 1999-2017," *National Vital Statistics Reports* 68, no. 5 (May 22, 2019): 1-9, https://www.cdc.gov/nchs/data/nvsr/nvsr68/nvsr68_05-508.pdf.

71. Francis O'Donnell, Shauna Stahlman, and Alexis A. Oetting, "Incidence Rates of Diagnoses of Cardiovascular Diseases and Associated Risk Factors, Active Component, U.S. Armed Forces, 2007-2016," *Medical Surveillance Monthly Report* 25, no. 3 (March 2018): 12-18, <https://www.health.mil/Reference-Center/Reports/2018/01/01/Medical-Surveillance-Monthly-Report-Volume-25-Number-3>.

72. "Nancy F. Crum-Cianflone et al., "Impact of Combat Deployment and Posttraumatic Stress Disorder on Newly Reported Coronary Heart Disease Among US Active Duty and Reserve Forces," *Circulation* 129, no. 18 (May 6, 2014): 1813-820, <https://doi.org/10.1161/CIRCULATIONAHA.113.005407>.

73. Taffet, "Normal Aging."

74. Phillip Maffetone, "The MAF 180 Formula: Heart-rate Monitoring for Real Aerobic Training," MAF, last updated July 2020, <https://philmaffetone.com/180-formula/>.

75. Taffet, "Normal Aging."

76. Jerome L. Fleg et al., "Accelerated Longitudinal Decline of Aerobic Capacity in Health Older Adults," *Circulation* 112, no. 5 (July 25, 2005): 674, <https://doi.org/10.1161/CIRCULATIONAHA.105.545459>.

The lungs are also a part of the cardiopulmonary system and play a significant role in aerobic fitness. Lung volume, however, can decrease with age due to changes in the musculature and bone structure surrounding and supporting the lungs. Chest wall flexibility reduces by approximately one-third between the age of thirty to 70 years old.⁷⁷ Muscles in the chest wall and the diaphragm also change, resulting in decreased efficiency.⁷⁸ The cumulative effects of these changes are minimal during midlife, especially for those that maintain a healthy, physically active lifestyle.⁷⁹

Many of the risk factors for the cardiopulmonary system's diseases are positively influenced by lifestyle choices, such as engaging in physical activity, eating a healthy diet, limiting alcohol consumption, and eliminating tobacco use.⁸⁰ Cardiopulmonary fitness is most known for playing a central role in reducing heart disease and improving the quality of life by reducing aging effects on multiple systems. Fortunately, cardiopulmonary fitness is not limited by age and can be enhanced throughout adulthood. For example, adults between sixty and eighty years old improved their aerobic fitness by 20-30% with training.⁸¹ For senior leaders, sustaining a high level of cardiopulmonary fitness addresses the leading cause of death in midlife and improves the quality of life throughout adulthood.

The Metabolic System

Metabolism is the process the body uses to convert dietary intake into the energy needed for the body to function and maintain physical activity.⁸² Moreover, metabolism involves the interaction of the digestive, endocrine, and cardiopulmonary systems in particular. The endocrine system drives the digestive system primarily through the thyroid gland, the adrenal glands, and the pancreas to control metabolism. The pancreas plays a significant role in health and makes the hormone insulin, which controls blood sugar levels.⁸³ Several changes to these systems occur during midlife that can significantly impact well-being.

77. M. Estenne, J.C. Yernault and A. De Troyer, "Rib Cage and Diaphragm-Abdomen Compliance in Humans: Effects of Age and Posture," *Journal of Applied Physiology* 59, no. 6 (1985): 1842, <https://doi.org/10.1152/jappl.1985.59.6.1842>.

78. Taffet, "Normal Aging."

79. Lally and Valentine-French, "8.1: Physical Development."

80. "Know Your Risk for Heart Disease," Heart Disease, Centers for Disease Control and Prevention, last reviewed December 9, 2019, https://www.cdc.gov/heartdisease/ricks_factors.htm.

81. Guoyuan Huang et al., "Controlled Endurance Exercise Training and VO_{2max} Changes in Older Adults: A Meta-Analysis," *Preventive Cardiology* 8, no. 4 (Fall 2005): 217-25, <https://doi.org/10.1111/j.0197-3118.2005.04324.x>.

82. Mayo Clinic Staff, "Metabolism and Weight Loss: How You Burn Calories," Weight Loss, Healthy Lifestyle, Mayo Clinic, October 8, 2022, <https://www.mayoclinic.org/healthy-lifestyle/weight-loss/in-depth/metabolism/art-20046508>.

83. "Endocrine System," Diseases and Conditions, Cleveland Clinic, last reviewed May 12, 2020, <https://my.clevelandclinic.org/health/articles/21201-endocrine-system>.

People often blame a slowing metabolism for weight gain during midlife, but the reason for weight gain is rarely that simple.⁸⁴ The term basal metabolic rate (BMR), or the number of calories your body requires at rest, is used interchangeably with resting metabolic rate.⁸⁵ Although BMR is dependent on gender, height, weight, and body composition, BMR also decreases with age. The *Dietary Guidelines for Americans* recommends simple diet modifications to reduce daily caloric intake by 200 to 400 calories per day between the ages of thirty and sixty, regardless of activity levels.⁸⁶ This caloric reduction is roughly equivalent to skipping a small, white chocolate mocha or a king-sized candy bar, suggesting that even small lifestyle choices can make important differences in midlife.

As caloric requirements decrease, body fat levels increase throughout midlife as body fat accumulates in the abdominal region.⁸⁷ Body fat levels increase beneath the skin, in muscle tissue, and within bones. Men tend to store fat in the upper abdomen and back, whereas women keep it in their waist and upper arms. Increased body fat, high blood pressure, harmful cholesterol levels, and elevated blood glucose levels are symptoms of a growing health crisis known as metabolic syndrome.⁸⁸

Metabolic syndrome is a cluster of risk factors that includes high blood pressure, high blood sugar, excess abdominal fat, and elevated cholesterol and triglyceride levels. Individuals with three of the five risk factors meet the criteria for metabolic syndrome.⁸⁹ It is becoming increasingly common in the United States and affects nearly one-third of the adult population.⁹⁰ It is closely related to insulin resistance, a condition where the muscle, liver, and fat tissue cells cannot use insulin correctly.⁹¹ Insulin resistance shares risk factors with metabolic syndrome and increases heart disease

84. Mayo Clinic Staff, "Metabolism and Weight Loss."

85. Scott Frothingham, "What Is Basal Metabolic Rate?" Healthline, November 12, 2018, <https://www.healthline.com/health/what-is-basal-metabolic-rate#takeaway>.

86. U.S. Department of Agriculture and U.S. Department of Health and Human Services, "Dietary Guidelines for Americans, 2020-2025," 9th Edition, December 2020, 139-141, https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf.

87. Lally and Valentine-French, "8.1: Physical Development."

88. Laura A. Crist et al., "Influence of Change in Aerobic Fitness and Weight on Prevalence of Metabolic Syndrome," *Preventing Chronic Disease* 9 (June 5, 2012), https://www.cdc.gov/pcd/issues/2012/11_0171.htm.

89. "Metabolic Syndrome," Health Topics, National Heart, Lung, and Blood Institute, National Institutes of Health, accessed on March 28, 2021, <https://www.nhlbi.nih.gov/health-topics/metabolic-syndrome>.

90. Mayo Clinic Staff, "Metabolic Syndrome," Diseases and Conditions, Mayo Clinic, last updated on March 14, 2019, <https://www.mayoclinic.org/diseases-conditions/metabolic-syndrome/symptoms-causes/syc-20351916>.

91. U.S. Department of Health and Human Services, Centers for Disease Control, *National Diabetes Statistics Report, 2014* (Atlanta 2014), 9, https://stacks.cdc.gov/view/cdc/23442/cdc_23442_DS1.pdf.

and stroke risks, especially in those that smoke.⁹² Additionally, insulin resistance and metabolic syndrome are associated with an increased risk of breast, colon, prostate, and uterus cancer.⁹³

Metabolic syndrome can also lead to type 2 diabetes.⁹⁴ Type 2 diabetes occurs when the pancreas does not produce enough insulin and cells do not utilize sugar appropriately. It develops slowly and is considered a part of aging that often goes unnoticed until complications arise.⁹⁵ As of 2018, 17.5% of adults in midlife had diabetes, with those in midlife experiencing a four-fold increase in diagnoses compared to younger adults.⁹⁶ The prevalence of diabetes continues to grow, despite campaigns to increase awareness. The American Diabetes Association (ADA) now recommends testing all patients over 45 years of age for diabetes, regardless of other risk factors. Moreover, the connection between diabetes and metabolic syndrome is highlighted by the finding that almost all cases of type 2 diabetes occur in overweight or obese individuals, a risk factor closely linked to insulin resistance and metabolic syndrome.⁹⁷

Metabolic syndrome is also associated with gastroesophageal reflux disease (GERD). Also known as heartburn, GERD is caused by acid from the stomach leaking into the esophagus through the lower esophageal sphincter.⁹⁸ Aside from the characteristic burning sensation in the chest, GERD produces an acid taste in the mouth and may include chronic sore throat, laryngitis, hoarseness, cough, chest pain, and difficulty swallowing.⁹⁹ The problem or discomfort experienced when swallowing is a condition called dysphagia. The acid associated with GERD causes irritation, scarring, or

92. "Metabolic Syndrome," Health Topics.

93. Sari Harrar, "What to Know About Insulin Resistance," Type 2 Diabetes, Endocrine Web, last updated March 29, 2019, <https://www.endocrineweb.com/conditions/type-2-diabetes/insulin-resistance-causes-symptoms>.

94. Mayo Clinic Staff, "Metabolic Syndrome."

95. Corinne O'Keefe Osborn, "Type 1 and Type 2 Diabetes: What's the Difference?" Healthline, last updated July 17, 2022, <https://www.healthline.com/health/difference-between-type-1-and-type-2-diabetes>.

96. U.S. Department of Health and Human Services, *National Diabetes Statistics Report 2020: Estimates of Diabetes and Its Burden in the United States*, Centers for Disease Control (Atlanta, 2020), 1-3, <https://www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.pdf>.

97. American Diabetes Association, "Diabetes Care: Standards of Medical Care in Diabetes - 2016: Summary of Revisions," *The Journal of Clinical and Applied Research and Education* 39, no. 1 (January 2016): S16, https://care.diabetesjournals.org/content/39/Supplement_1/S4; "Metabolic Syndrome," Health Topics.

98. Lamia Kallel et al., "Metabolic Syndrome is Associated with Gastroesophageal Reflux Disease Based on a 24-Hour Ambulatory PH Monitoring," *Diseases of the Esophagus* 24, no. 3 (April 2011): 153-59, <https://doi.org/10.1111/j.1442-2050.2010.01118.x>.

99. "Gastroesophageal Reflux Disease (GERD)," American Academy of Allergy, Asthma & Immunology, accessed on March 30, 2021, <https://www.aaaai.org/conditions-and-treatments/related-conditions/gastroesophageal-reflux-disease>.

constriction that prevents the muscles of the esophagus from swallowing correctly.¹⁰⁰ Left untreated, GERD can lead to ulcers in the esophagus, pain in the chest, difficulty swallowing foods, bleeding, and cancer.¹⁰¹ GERD may also lead to a condition known as Barrett’s Esophagus, where the cells lining the esophagus become more like intestinal cells. This cellular change places one at greater risk of forming adenocarcinoma, a type of cancer seen in the lower portion of the esophagus.¹⁰² While these conditions require consultation with medical professionals, lifestyle changes can positively impact and will likely be prescribed as part of the treatment.

Lifestyle choices that include improved diet, increased physical activity, and weight loss reduce the likelihood of adult-onset diabetes and can also be used to address metabolic syndrome.¹⁰³ For example, maintaining physical activity across the lifespan has a long-lasting, positive impact on insulin resistance.¹⁰⁴ Building fitness at an advanced age can still impact insulin sensitivity, even into the late 70s.¹⁰⁵ Different exercise modalities to include high-intensity interval training can improve insulin sensitivity in older adults.¹⁰⁶ Physical activity alone, however, is not enough and must be combined with a healthy diet. In one study, following the ADA’s recommendations to include physical activity and caloric restriction resulted in a 44% decrease in the incidents of the disease.¹⁰⁷ See Chapter 3 for more information about physical activity and Chapter 4 for more information on diet.

Specific lifestyle changes can help those experiencing GERD. Eating smaller meals, not eating late at night, avoiding fatty or fried foods that aggravate the condition, and limiting alcohol and caffeine intake can reduce GERD’s

100. Erica Roth, “Difficulty Swallowing (Dysphagia) Due to Acid Reflux,” Healthline, last updated September 28, 2018, <https://www.healthline.com/health/gerd/dysphagia#causes>.

101. “GERD (Chronic Acid Reflux),” Diseases and Conditions, Cleveland Clinic, last reviewed December 6, 2019, <https://my.clevelandclinic.org/health/diseases/17019-gerd-or-acid-reflux-or-heartburn-overview>.

102. “Barrett’s Esophagus,” Diseases and Conditions, Cleveland Clinic, last updated June 23, 2020, <https://my.clevelandclinic.org/health/diseases/14432-barretts-esophagus>.

103. American Diabetes Association, “Diabetes Care”; Mayo Clinic Staff, “Metabolic Syndrome.”

104. Tipwadee Bunprajun et al., “Lifelong Physical Activity Prevents Aging-Associated Insulin Resistance in Human Skeletal Muscle Myotubes via Increased Glucose Transporter Expression,” *PLOS One* 8, no. 6 (June 21, 2013), <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0066628>.

105. Ellen M. Evens et al., “Aerobic Power and Insulin Action Improve in Response to Endurance Exercise Training in Healthy 77-87 Yr Olds,” *Journal of Applied Physiology* 98, no. 1 (January 2005), <https://doi.org/10.1152/jappphysiol.00928.2004>.

106. Ditte Sogaard et al., “High-Intensity Interval Training Improves Insulin Sensitivity in Older Individuals,” *Acta Physiologica* 222, no. 4 (April 2018), <https://doi.org/10.1111/apha.13009>.

107. Richard F. Hamman, et al., “Effect of weight loss with lifestyle intervention on risk of diabetes,” *Diabetes Care* 2006; 29:2102-2107, <https://doi.org/10.2337/dc06-0560>.

effects.¹⁰⁸ Healthcare professionals also recommend smoking cessation to help control metabolic syndrome, diabetes, and GERD. Although smoking has historically been considered the leading risk factor for heart disease, the National Institutes of Health may identify metabolic syndrome as the leading risk factor.¹⁰⁹

The Reproductive System

The reproductive system consists of the organs involved in sexual reproduction.¹¹⁰ For senior leaders in midlife, there are two areas of concern related to the reproductive system. The first area of concern is related to the system's primary ability to reproduce. The second area concerns the hormones produced by the reproductive organs that impact hormone levels in other systems. Each gender has unique challenges in these areas and will be addressed separately.

During midlife, most women will enter a period called perimenopause. This period is generally characterized by decreased estrogen and progesterone production in the ovaries and occurs eight to ten years before menopause.¹¹¹ On average, menopause occurs at fifty-one years old and is defined by twelve months without a menstrual cycle.¹¹² Menopause can result naturally with age or when the ovaries do not produce enough estrogen and progesterone due to external factors. Moreover, it can be induced by surgically removing the ovaries or cancer treatments involving chemotherapy and radiation.¹¹³

Menopause is characterized by a host of symptoms that can be highly disruptive and can also lead to an increased risk of heart disease, weight gain, and osteoporosis.¹¹⁴ For example, decreasing hormone levels can raise cholesterol levels and arteriosclerosis, thereby elevating the risk for heart

108. Mayo Clinic Staff, "Gastroesophageal Reflux Disease (GERD)," Diseases & Conditions, Patient Care & Health Information, Mayo Clinic, last updated May 22, 2020, <https://www.mayoclinic.org/diseases-conditions/gerd/symptoms-causes/syc-20361940>.

109. National Heart, Lung, and Blood Institute, "Metabolic Syndrome."

110. Melissa Conrad Stoppler, "Medical Definition of Reproductive System," MedicineNet, last reviewed March 29, 2021, https://www.medicinenet.com/reproductive_system/definition.htm.

111. "Postmenopause," Diseases and Conditions, Cleveland Clinic, last reviewed October 5, 2021, <https://my.clevelandclinic.org/health/diseases/15224-menopause-perimenopause-and-postmenopause>.

112. Lally and Valentine-French, "8.5: Climacteric."

113. Mayo Clinic Staff, "Menopause: Symptoms and Causes," Diseases and Conditions, Mayo Clinic, last updated October 14, 2020, <https://www.mayoclinic.org/diseases-conditions/menopause/symptoms-causes/syc-20353397>.

114. Mayo Clinic Staff, "Menopause: Symptoms and Causes."

disease.¹¹⁵ Lower basal metabolic rates, combined with reduced physical activity levels, can result in weight gain. In addition, the complex interaction of hormones on bone mineral density can increase the risk of osteoporosis.¹¹⁶ While many symptoms of menopause require medical intervention to address, these three symptoms can be influenced by healthy lifestyle choices.

Regular aerobic exercise and strength training can play a critical role in mitigating the effects of menopause and may alleviate some of the symptoms.¹¹⁷ Exercise must be combined with a healthy diet to counteract the results of a slowing metabolism. Eliminating tobacco use, limiting caffeine consumption, and drinking alcohol only in moderation can also ease some symptoms.¹¹⁸ Although healthy lifestyle choices and some prescription medicines may help mitigate the symptoms and effects of menopause, some women may need to visit their primary healthcare provider for more definitive care.¹¹⁹ For example, a doctor may prescribe hormone replacement therapy in certain situations, particularly for moderate to severe hot flashes, and prevent bone density loss. Hormone replacement therapy is not without risks and has been associated with an increased risk of heart disease, stroke, blood clots, and breast cancer.¹²⁰ The indications for hormone replacement depend on several individualized factors, including age, family history, previous medical conditions, and severity of symptoms. If, after consultation with a doctor, hormone replacement therapy is appropriate, the importance of managing risk factors through lifestyle remains.¹²¹

Men also experience a decline in fertility as they age that has already begun by midlife.¹²² Although the number and viability of sperm cells men

115. Kristeen Cherney, "Premenopause, Perimenopause, and Menopause." Healthline, last updated August 28, 2020, <https://www.healthline.com/health/menopause/difference-perimenopause>.

116. "Menopause, Perimenopause and Postmenopause," Diseases and Conditions, Cleveland Clinic, last reviewed December 24, 2019, <https://my.clevelandclinic.org/health/diseases/15224-menopause-perimenopause-and-postmenopause>.

117. "Menopause, Perimenopause and Postmenopause," Cleveland Clinic.

118. Kristeen Cherney, "Premenopause, Perimenopause, and Menopause," Healthline, last updated August 28, 2020, <https://www.healthline.com/health/menopause/difference-perimenopause>.

119. Mayo Clinic Staff, "Menopause: Diagnosis and Treatment," Diseases and Conditions, Mayo Clinic, last updated October 14, 2020, <https://www.mayoclinic.org/diseases-conditions/menopause/diagnosis-treatment/drc-20353401>.

120. North American Menopause Society, "The 2017 Hormone Therapy Position Statement of The North American Menopause Society," *Menopause: The Journal of the North American Menopause Society* 24, no. 7 (2017): 728-53, <http://www.menopause.org/docs/default-source/2017/nams-2017-hormone-therapy-position-statement.pdf>.

121. Janice Rymer, Ruth Wilson, and Karen Ballard, "Making Decisions about Hormone Replacement Therapy," *British Medical Journal* 326, no. 7384 (February 8, 2003): 322-26, INSERT MISSING URL HERE.

122. Taffet, "Normal Aging."

produce diminish with age, research suggests that men remain sexually active well into their sixties and seventies.¹²³ However, in some cases, men do not generate enough testosterone, resulting in low sex drive, erectile dysfunction, fatigue, and muscular strength loss.¹²⁴ Although television commercials would suggest otherwise, the American Urological Association reports that only about 2.1% of men have low testosterone, with the preponderance occurring at an older age.¹²⁵ Many factors can affect testosterone production, including accidental damage to the testes, infection, chemotherapy or radiation, obesity, metabolic syndrome, drug use, aging, or removal due to cancer.¹²⁶ Additionally, low testosterone is more common in overweight, obese, or diabetic men. Consequently, doctors may recommend lifestyle changes to address these conditions in addition to conducting blood tests to determine testosterone levels.¹²⁷

Doctor prescribed treatment for low testosterone involves testosterone replacement therapy administered via skin patches, gels, pellets implanted under the skin, or injections.¹²⁸ Like hormone replacement therapy for women, testosterone replacement therapy has potential health risks for men. For example, testosterone replacement therapy increases cardiovascular disease risk, prostate cancer and may interrupt sperm production.¹²⁹ Ironically, testosterone therapy is not always effective in reducing symptoms of low testosterone. A review of 156 randomized controlled trials found that testosterone therapy did not benefit cardiovascular health, sexual function, muscle strength, mood, or cognitive function. In contrast, progressive resistance training improves sex hormone levels in older men.¹³⁰ Moreover, overweight and obese men had significantly lower testosterone levels than men with a healthy weight. Vigorous aerobic exercise can also increase testosterone levels.¹³¹

123. John DeLamater, "Sexual Expression in Later Life: A Review and Synthesis," *Journal of Sex Research* 49, no. 2/3 (March-June 2012): 125-41, <https://www.jstor.org/stable/23249140>.

124. "Low Testosterone (Male Hypogonadism)," Diseases and Conditions, Cleveland Clinic, last reviewed on September 2, 2022, <https://my.clevelandclinic.org/health/diseases/15603-low-testosterone-male-hypogonadism>.

125. "What is Low Testosterone?" Urology A-Z, Low Testosterone, Urology Care Foundation, accessed on March 27, 2021, <https://www.urologyhealth.org/urology-a-z/1/low-testosterone>.

126. "Low Testosterone (Male Hypogonadism)," Cleveland Clinic.

127. Matthew Solan, "Treating Low Testosterone Levels," Harvard Health Publishing, Harvard Medical School, last updated August 9, 2019, <https://www.health.harvard.edu/mens-health/treating-low-testosterone-levels>.

128. "Low Testosterone (Male Hypogonadism)," Cleveland Clinic.

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Conclusion

Senior leader health and wellness is an issue of strategic importance. Not only do senior leaders have significant influence over their institutions, but they also serve as role models and mentors for the people they lead. Senior leaders experience many physiological changes during midlife. Some of these changes are related to biological functions over which they have little control. However, many changes attributed to age are influenced by lifestyle choices that senior leaders can control. Maintaining a healthy lifestyle will contribute to their productivity and quality of life now and well into the future. Vigorous physical activity, a healthy diet, adequate rest, stress management, and weight management combine to reduce the adverse effects of aging on the musculoskeletal, neurocognitive, cardiopulmonary, metabolic, and reproductive systems, and the risk factors identified for heart disease, metabolic syndrome, and diabetes. Understanding how the body will change and what lifestyle choices can produce positive outcomes is part of a holistic approach to health and wellness.

Key Takeaways

- Many changes attributed to age are influenced by controllable lifestyle choices.
- By making healthy lifestyle choices, senior leaders can remain physically fit and avoid many unpleasant age-related changes while mitigating the biological changes that lead to frailty later in life.
- Exercise allows senior leaders to maintain their strength and endurance longer across their lifespans. Similarly, sustaining a high level of cardiopulmonary fitness addresses the leading cause of death in midlife and improves the quality of life throughout adulthood.
- Lifestyle choices that include improved diet, increased physical activity, and weight loss reduce the likelihood of adult-onset diabetes and can also be used to address metabolic syndrome.



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