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Lifelong Health: Achieving Optimum Well-Being at Any Age

Course Guidebook

Professor Anthony A. Goodman
Montana State University

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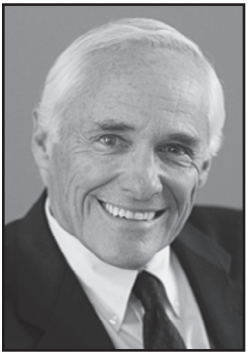
4840 Westfields Boulevard, Suite 500
Chantilly, Virginia 20151-2299
1-800-832-2412
Fax—703-378-3819
www.thegreatcourses.com



Anthony A. Goodman, M.D., F.A.C.S.

Adjunct Professor of Medicine,
Montana State University

Dr. Anthony A. Goodman received his B.A. from Harvard College and his M.D. from Cornell Medical College. He trained as a surgical intern and resident at the University of Michigan Medical Center in Ann Arbor and completed his surgical training and served as chief resident at the Harvard Surgical Service of Boston City Hospital, New England Deaconess Hospital, Lahey Clinic, and Cambridge City Hospital.

Dr. Goodman served as a surgeon on the hospital ship for Project HOPE and served with the U.S. Army Medical Corps from 1971 to 1973. From 1973 to 1992, he was a general surgeon, specializing in the surgical treatment of cancer, and was Clinical Associate Professor of Surgery at the University of Miami School of Medicine. In 1991, he was Visiting Professor of Surgery at the Christchurch Clinical School of Medicine in Christchurch, New Zealand.

Dr. Goodman has served as an examiner for the American Board of Surgery. He is a Fellow of the American College of Surgeons and a Diplomate of the American Board of Surgery. He has been a member of the American Society of Colon and Rectal Surgeons and the British Association of Surgical Oncology. He was the founder of the Broward Surgical Society. He has published numerous papers on both clinical and experimental surgery.

At present, Dr. Goodman is Adjunct Professor of Medicine in the WWAMI Medical Sciences Program at Montana State University, where he teaches gross anatomy, and Affiliate Professor in the Department of Biological Structure at the University of Washington School of Medicine.

Dr. Goodman is also the author of a work of historical fiction, *The Shadow of God: A Novel of War and Faith* (Sourcebooks Landmark, 2002). ■

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I especially want to acknowledge my wife, Maribeth Goodman, who collaborated with me from the beginning on course design, research, and writing. Maribeth has helped me enjoy a healthier, happier, and, I believe, longer life. My fondest wish is that this course will help you do the same.

A percentage of the professor royalties from this course will be donated to the PACE Center for Girls Teresa Haran Radice Health & Wellness Center.

Disclaimer

This series of lectures is intended to increase your knowledge of nutrition, exercise, and health-related lifestyle choices and their basic effects on the human body. They are not designed for use as medical references to diagnose, treat, or prevent medical illnesses or trauma. Neither The Teaching Company nor Dr. Anthony Goodman is responsible for your use of this educational material or its consequences. If you have questions about the diagnosis, treatment, or prevention of a medical condition or illness, you should consult your personal physician.

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SUPPLEMENTAL MATERIAL

Lifelong Health:
Achieving Optimum Well-Being at Any Age

Scope:

There is a little-known aspect of human aging that few of us—including me, until recently—consider: There is no scientific or medical way to determine the age of any individual human being. People can tell us their age or show us a birth certificate, but beyond that, there is no science that can put an age or date of birth on someone. We have no annual rings, as trees do; no way to count teeth, the way we do with horses. There are no biopsies or technologies that enable us to examine DNA or tissues that would allow even the most sophisticated scientist to give us an accurate age. The most we can do is guess, generally with perhaps a 10- or 20-year range. To me, this opens a wonderful door to a hopeful future, for it allows us to aspire to a long and healthy life with few constraints as to how we might choose to live that life. The possibilities for healthy, productive, and joyful years ahead of us seem, in many ways, limitless.

What, then, can each of us do to achieve and maintain optimum health and well-being? Although conventional wisdom has shown that 35 to 40 percent of longevity might be determined by genes, 60 to 65 percent is within your control, which means that *you have a choice in how you are going to live*. My overall objective in this course is to help you see your options and make educated health-related decisions for a lifetime of good health and well-being.

In this course, we present an accessible, science-based program to help preserve your health and enhance your quality of life at any age. The lectures explain how and why the body and mind age and how you can build the pillars of a health-maintenance program: good nutrition, beneficial exercise, stress-relieving relaxing and restorative activities, and more and varied healthful lifestyle choices. We will explore and redefine the currently misunderstood concepts of those pillars of good health within the context of evidence-based medicine and anecdotal evidence. And, of course, my more than 40 years

of experience in the medical profession allow me to draw some reasonable conclusions, which I will share when appropriate.

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Nutrition, exercise, and stress reduction are the pillars of a healthy lifestyle.

We will begin this course by studying the physiological, psychological, and cultural components of aging. In addition, we will look at general misconceptions and myths about aging, talk about ways to prevent illness and enhance good health, and investigate some of the medical advancements on the horizon. Then we will turn to the first pillar of our health maintenance program: nutrition. In the nutrition lectures, I will emphasize the idea that "diet" should be defined as "a way of eating" as opposed to "a way to lose weight." We will focus on eating healthy, fresh, whole foods; explore a wide array of alternatives to some of today's popular rigid diet programs; and learn practical eating habits that will serve us for a lifetime.

In our lectures about beneficial exercise, I will promote physical activities of all sorts as enjoyable ways to keep your body moving, so that throughout life, fitness will be a byproduct of activities you like to do. After a general guide to the basic physiology and anatomy of exercise, we will discuss activities that make us stronger, healthier, and better able to enjoy all other aspects of life. We will discuss the multitude of exercise options available to us all, including some that you may have never considered—though perhaps you should!

The mental health and mindfulness lectures will encourage you to use your mental capacity to its fullest at every age, from youth through advanced years. These lectures will explain clearly the benefits of mindfulness, meditation,

and relaxation as ways to reduce stress, improve emotional well-being, and bring balance and calm to every area of life. After a section addressing health issues specific to men, women, and children, the lectures on healthy choices will cover topics that affect all of us and our loved ones every day, such as sleep, hydration, alcohol and tobacco use, social connections, laughter, and the importance of becoming an educated patient.

The major themes of this course will serve you no matter how the science changes, and you will hear me repeat them time and again:

1. *Small changes can make a big difference*. A one-degree course change for a big ship eventually makes a significant change in that ship's trajectory. In the same way, if you start with small positive changes, over time, your efforts will culminate in a substantial positive effect on your health.

2. *Moderation is key*. Just as your body is designed to achieve homeostasis, so, too, is it important for you to find balance when making choices regarding food, exercise, and other areas that affect your health and well-being. Some parameters and guidelines will tend to serve you well over time, and I will encourage you to find the ones that work for you for the long term.

3. *It's not nice to fool Mother Nature*. There are no magical places, times, pills, or potions that can keep you eternally young, but there are many things you can do to improve how you feel and how you live your life.

4. *Remember the Goldilocks rule*. At all times of your life, *you* will have the opportunity to make the best choices that bring *you* joy and good health and that *you* can maintain and sustain.

In short, I hope to help you improve your health and well-being by providing you with evidence-based information and a variety of resources for continuing education, as well as countless great choices that suit your needs, preferences, interests, and abilities. ■

A Personal Path to Lifelong Health

Lecture 1

You can be your own teacher for your entire life. You need to know how and where to get accurate information, and you need to have a good detector for when there's baloney out there.

The purpose of this course is to present various scientifically documented options on the path to optimum health. We'll explore and redefine the currently misunderstood concepts of aging, diet, mental health, lifestyle choices, and exercise, all within the context of the clashes of so-called expert opinions. The information will be presented in a way that will enable you to make personalized choices as you seek to nourish and strengthen your body in ways that are adaptable and appropriate to your changing age and stage of life. We'll focus on healthy aging that benefits from nutritious whole foods, in combination with enjoyable and sustainable physical activities. We'll also look at maintaining mental acuity and calmness of mind and lifestyle changes that can easily be incorporated into our daily lives. The overall objective is to supply you with a lifetime of guidance toward achieving health and well-being, no matter what your age.

Fresh, whole foods are essential to a healthy nutrition plan.

You will also learn about resources for continuing your education and for using evidence-based science and medicine. You'll see the distinction between evidence-based medicine, which is hard science, and anecdotal medicine or anecdotal evidence, which is no science at all. You'll learn some of the things that can be measured and some that can't, and you'll see the importance of careful data analysis. We'll explore the concepts of

absolute risk and relative risk, along with margin of error. As much as possible, our data will come from randomized, prospective, double-blind studies published in peer-reviewed journals.

We can identify two simple rules to follow when looking for medical information or advice. First, don't accept advice from anybody just because he or she is wearing a white coat. Second, be sure that the source of your information is not receiving money by selling you the product or service in question.

We're going to find joy in good nutrition, and we're going to find a practical way of eating that will last you a lifetime.

One of the goals for this course is to find a way to live our lives with optimum health, mindfulness, joy, and freedom. For example, I don't believe there's any reason to try to maintain weight by dieting if it leaves you always feeling hungry or deprived. And there's no reason to count the minutes in your exercise program or just get it out of the way. I define diet as a way of eating, as opposed to a way to lose weight, and I focus on healthy, fresh foods as a whole style of nutrition. I also believe that physical activity should be enjoyable.

We'll return to a number of major themes throughout this course. One of these is that small changes make a huge difference. Another is the benefit of "all things in moderation." Our bodies, which are controlled by our genes, are designed to achieve a balance—homeostasis. Still another theme is the Goldilocks rule: Find the guidelines and parameters related to nutrition, exercise, mental health, and lifestyle that are a good fit for you. ■

Important Term

absolute risk: The actual numerical chance or probability discovered during a study, presented without context, using numbers or percentages.

Questions to Consider

1. Discuss the nature-versus-nurture controversy as it might apply to aging and longevity.

2. List five common physical and/or mental changes that you believe generally occur with aging. Which do you feel are inevitable, and which can be modified?

The Cellular Biology of Aging

Lecture 2

How we age is going to vary from person to person, but change is inevitable. We can't stop that. It's how we become mindful of the changes that is often one of the biggest challenges in our lives.

The common changes associated with aging are similar in all of us. In general, we have an increasing proportion of body fat versus bone and muscle. This can affect health in many ways. For instance, older people sometimes lose balance and equilibrium, strength, and mobility, which can begin a vicious cycle. Metabolic rate begins to creep down and weight begins to creep up, initiating other changes, such as heart disease, diabetes, and many kinds of cancer. However, these don't have to be invariable accompaniments to aging. The good news for all of us is that aging in our time has markedly improved from the era of our grandparents and great-grandparents.

Probably about a third of the aging process is determined by our genes (nature) and almost twice as much is determined by our environment (nurture), which we can control to a great extent. With our fast-paced lifestyles, we have access to shortcuts, such as fast foods, that support our faster pace but are detrimental to our health. We get inadequate sleep, and we consume drugs that artificially upregulate our already fast pace. Yet in spite of all this, many of us are living longer and healthier lives because, with increased awareness, we can choose to create improved health. We can, in fact, bypass illnesses and frailties that many in the medical community have come to accept as part of "normal aging," such as diabetes, cardiovascular disease, and cancer. Many of these diseases can be prevented, slowed down, or even reversed. What is required of us is that we listen to our bodies and respond with new choices.

To understand how we age well, we need to understand the biologic process of aging. Cellular aging starts at birth. Shortly after birth, the body begins to lose some resiliency. Cells take on specific functions. They achieve specialization, and as they do so, they begin to use up their allotted number

of replications. This is important because we need to replace dying or injured cells, and when we no longer have enough replacement cells, we've got a problem. Human cells have about 30 to 50 divisions before they lose their ability to reproduce. This number of divisions is called the Hayflick limit. Our individual cells replicate based on need. Red blood cells, for example, turn over completely in 120 days, while bone cells take years. Adult stem cells can replace many of these lost cell lines, but these are specific to each kind of tissue.

Once we decide not to fight aging and the aging process, we accept the fact that we will age. Then we can begin to take control of how we age.

The most important limit on our cellularity probably comes from telomeres. The telomeres are the end bodies of our chromosomes. At every replication, a little bit of the telomere is lost; eventually, all the telomere is lost and replication is impossible because the integrity of the chromosome is gone. There is an enzyme called telomerase that repairs those ends, but normal cells don't have it. Some people have suggested introducing telomerase into normal cells as a way to increase longevity, but such tinkering might encourage the production of cancer cells. We need to find other roads to life extension. ■

Questions to Consider

1. What is the Hayflick limit, and how can it affect longevity?

2. Discuss the role of telomeres in the aging process.

The Physiology of Aging

Lecture 3

There was a man named Claude Bernard who was a 19th-century French physiologist, and he is known to this day for the saying "The constancy of the internal environment is the condition for a free and independent life." What he meant was that organisms, all organisms, really need to keep the chemistry and the biology of our cells, of our organs, absolutely constant within very, very narrow limits.

In the last lecture, we saw that the body's "house" has a relatively finite number of bricks and boards and that, as we age, we have fewer and fewer replacement parts. Those are the built-in limitations of our house. In this lecture, we'll look at external stresses that cause aging and what we can do to protect ourselves from them.

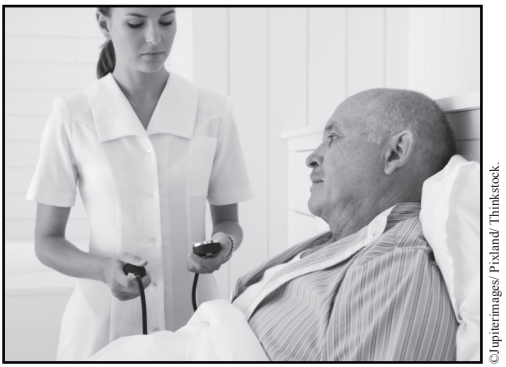
There are a number of basic ideas about what makes us lose the resiliency of youth, including simple wear and tear, somatic or genetic mutation, and autoimmune overreaction. We'll begin by talking about the implications of free radicals on aging. Two atoms normally form a molecule by linking pairs of electrons in their outer shells. If a molecule loses one member of a pair, it becomes a free radical, which will then seek to bind with an electron from a nearby molecule to regain its normal state. Th is molecule might unite with, for example, a molecule of DNA. The extra molecule might then interfere with the DNA's process of protein manufacture.

At the same time, free radicals are also part of a normal defense mechanism in the body called **apoptosis**—programmed suicide of abnormal or dangerous cells. There is an ongoing normal balance between the free radicals necessary for good health and protection and excessive free radicals causing cellular and tissue damage.

Let's turn to the effects on aging of glucose, the most common sugar in the body. Excess glucose in the body plays an important role in many diseases and in the process of aging. In a process called glycation, excess glucose molecules may be inserted into proteins, DNA, or fats; they form a bound

complex in these molecules and may destroy function. For example, this irreversible cross-link can cause loss of elasticity in tissue. It also causes many of the problems that diabetics suffer from, as well as cataracts, and may contribute to Alzheimer's disease.

In general, the younger body heals faster and is far better adapted to defend against invasive chemicals. It tends to have better cellular nutrition and vascularity—blood flow to tissues and organs. Young people have more active cellular **metabolism**, energy production, and detoxification systems than older ones.



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In general, a younger body heals faster and has better blood flow to tissues and organs.

As we age, dramatic changes begin to take place deep in the layers of the dermis and express themselves on the surface of the skin. For example, we lose sebaceous glands, which can cause skin brittleness and susceptibility to infection. The production of synovial fluid, which lubricates joints, also decreases in older people, and the cartilage between jointed bones becomes thinner. We also lose control of the fluid, electrolyte, and acid-base balance in our bodies. This affects the heart and other organs. As a result of downregulation of the immune system, older people are more susceptible to all kinds of invasion, from infection to malignancy. Most of us, however, can take steps to slow down these changes and keep good function. ■

Important Terms

apoptosis: Programmed cell death.

metabolism: All energy processes in the body, including consumption and expenditure of energy, as well as renewal of energy.

Questions to Consider

1. How does circulating glucose relate to the aging of cells?

2. Define and discuss the possible effects of free radicals on human cells.

Myths of Aging—Magical Times and Places

Lecture 4

The other philosophical view which we could and probably should take is that aging and death are, on the one hand, reverse sides of the same coin as youth and life. It's what gives life meaning and beauty and urgency and poignancy—the fact that we know we're going die.

Chronologic age is the number you arrive at by starting with the day you were born and counting forward. Biologic or physiological age is the state of wellness or illness as a total reflection of each of us as functioning organisms. Aging is a continuous process, but the rate at which we age is variable. You may be able to modify your lifestyle so that the process is exciting and productive while it continues. How quickly or slowly we age depends on how we preserve our function or how our function declines.

As a society, we have been engaged in a campaign to find a fountain of youth, something that will make us live for a very long time. This has spawned a multibillion-dollar industry that, in the end, has produced almost nothing of value. Professor Jay Olshansky of the School of Public Health at the University of Illinois described basically three legends in the quest for immortality: the antediluvian legend (meaning "before the flood"), hyperborean legends (eternal youth derived from a magical place "beyond the north wind"), and fountain-of-youth legends.

In almost every successive generation of humans, average lifespan has surpassed that of the generation before it. There is no scientific evidence to show that in some antediluvian time, longevity was much greater than what we have seen over recorded history. We also have no evidence that a magical environment exists where people live extraordinarily long lives, although there are some areas where longevity is remarkable, such as Okinawa in Japan, Abkhazia in the former Soviet Union, and Loma Linda, California. These environments have no commonalities of geography or ethnicity, but they are all clean and nontoxic, and the people there share several lifestyle factors that contribute to longevity. They all tend to have a low **body mass**

index (**BMI**); they eat healthy diets rich in vegetables and fruits; they have low meat intake; they use very few chemicals except salt to preserve their food; they engage in consistent, lifelong, strenuous physical activity; and they have strong social ties. We can incorporate many of these factors into our own lifestyles.

The good news is that every region of the world has places that can support healthy and productive people over the age of 100 years old. These "blue zones" are getting more and more press, but we should remember that the people there have adopted lifestyle changes over generations that suit them very well. There's nothing magical in those places. We can add to our longevity by making the same adaptations to our lifestyles.

In the next lecture, we'll turn to the myths and truths about magical foods, medicines, and supplements to see what their place is in the search for longevity and healthy lives. ■

Important Term

body mass index (**BMI**): The standard method of determining an individual's healthy weight range by height-to-weight ratio. To calculate, multiply your weight in pounds by 703, and divide by your height in inches squared.

Questions to Consider

1. Discuss some of the commonalities in lifestyle that are found in places where people tend to have extreme longevity (the blue zones).

2. Which of those blue-zone lifestyle choices have you adopted?

Myths of Aging—Magical Substances

Lecture 5

There's no fountain of youth; there's no free lunch when it comes to drugs, natural or synthetic. The bottom line for me is that nothing like these will stop or reverse the aging process.

The fountain of youth is the most prevalent of all the immortality myths. Its adherents look for miracle drugs, foods, or restorative substances that will prevent aging. You may have heard, for example, about human growth hormone (HGH). HGH is secreted from the anterior pituitary lobe to stimulate cell growth and reproduction. The positive effects of naturally occurring HGH in the body include reduction of body fat, increase in muscle mass and bone density, enhancement of skin tone and texture, and increase in energy level. The normal effects of naturally secreted HGH have led to a search for other ways to improve human performance.

The industry wants you to buy this stuff and they want you to use it, and it's purely a matter of money and not health.

In a study reported by the *New England Journal of Medicine*, a very small group of men over age 60 who were treated with HGH experienced significant increases in lean body mass, meaning growth of muscles, and bone density. A later study at Stanford University concluded that HGH allowed the body to accumulate more water in the muscles but didn't promote muscle growth or strength. Researchers also found that using HGH regularly brought on negative side effects, including an increase in **type 2 diabetes**. Furthermore, virtually all cancers require large amounts of insulin-like growth hormone, which is similar to HGH; this means that using HGH could stimulate cancer growth.

Anabolic steroids are hormones whose function is to increase protein synthesis in cells, causing cellular tissue to build up. Without question, anabolic steroids make users bigger and stronger, but long-term use or

excessive doses can result in serious health risks, such as an increase in low-density lipoprotein (LDL, bad cholesterol) and a decrease in high-density lipoprotein (HDL, good cholesterol). These steroids also raise blood pressure, cause liver damage, increase the risk of prostate cancer in men, and disrupt the menstrual cycle in women.

Glucose meters are used for monitoring your blood sugar levels in the privacy of your home.

Another widely misused drug, dehydroepiandrosterone (DHEA), is also a naturally occurring hormone in the body, manufactured in the adrenal glands. It's a precursor for the sex steroids, both androgens and estrogens, so both men and women have it. DHEA has been touted as a way to stop or reverse numerous age-related diseases, but again, studies have found no benefit for elderly patients.

Cell therapy involves ingestion or injection of cells taken from embryonic animals, with the idea that these cells have ingredients derived from the pluripotent stem cell that could confer youth and antiaging properties. However, such cells don't migrate to targeted areas in the body and contain foreign animal proteins that can be dangerous to humans.

Finally, many herbs and medicines have been promoted for antiaging uses because they are natural, but there's nothing in the definition of "natural" that means things are safe or beneficial for human health. In fact, many natural substances that are beneficial to humans can also be toxic or fatal if taken incorrectly. Some of the biggest problems with natural remedies have to do with bioavailability—the dose and dose delivery.

Ultimately, when we get to the bottom of the list of things we might look for to help us live forever, there just isn't anything out there. We need to look to

time-tested methods of ameliorating the ailments that come with advancing age without resorting to "miracle" cures. ■

Important Term

type 2 diabetes: Also called adult-onset diabetes, this is the most common form of diabetes, in which the body produces insulin but does not use it effectively.

Questions to Consider

1. List five effects of naturally occurring HGH on adult humans. List three dangers associated with the use of pharmacological doses of HGH.

2. What are the pros and cons of using anabolic steroids to improve performance in sports?

Optimizing Health—Tests and Procedures

Lecture 6

In 2005, the number was 2.5 million adult deaths in the United States; that's just how many grown-ups died. An estimated 500,000 of those—20 percent—were linked to smoking. About 400,000 were linked to hypertension (high blood pressure).

In this lecture, we'll talk about which tests and routine examinations can help us stay ahead of the curve in health care. Recall our discussion about relative and absolute risk in Lecture 1. Studies have shown that a 35-year-old woman has twice the relative risk of dying in an accident as she has of dying of breast cancer in the subsequent 10 years. Both of those are rare events; that's absolute risk. At that age, a woman is not likely to die of either event, so that statistic doesn't help us. Similarly, a 55-year-old male smoker has the same chance of dying in the subsequent 10 years as a 65-year-old male nonsmoker. It's hard to make any sense of that except to know that life is a risky business.

What risks can be screened for, and what other steps can we take to avoid those risks?

What are some of the big risks that can be screened for, and what steps can we take to avoid those risks? In 2009, the Harvard School of Public Health released a study showing that smoking and high blood pressure are the two leading causes of death in the United States overall. This, we can do something about. With regard to smoking and high blood pressure, most of the responsibility lies in our choices.

One of my medical school professors taught his students never to order a test unless the results would change how the patient would be treated. At the same time, we have a huge armamentarium of good tests that can help us intervene and either treat or prevent many serious illnesses. For example, in recent years, two gene mutations have been discovered that are linked to both breast and ovarian cancers, but only a small fraction of women have enough factors to justify screening for the mutations and taking action to prevent the possibility of cancer. Screening mammography, however, has been shown to have a protective effect for large numbers of women in the age group 50 to 69 years old.

For most patients, history and physical exam alone are enough to make a diagnosis. A routine serum cholesterol screening is helpful because it's easy, inexpensive, accurate, and predictive for future serious disease. Other tests that may provide an early diagnosis for diseases that can be treated include a Pap smear and a colonoscopy.

With **hypertension**, the diagnosis has become much stricter. We now believe a blood pressure of 120/80 or above is borderline hypertension. The higher number (systolic pressure) is the peak pressure that your blood vessels sustain when your heart is pumping, which gives you a higher risk for stroke because the pressure is also up in your brain. The diastolic, the lower number, is the pressure as your vessels relax.

DEXA scans, which measure the minerals in the bones, can detect early osteoporosis, which is a signal for risk of fractures. Finally, the stress test, an exercise treadmill test, is designed to pick up disease in the coronary arteries. The availability of all these tests leads us back to the need for doctors to take detailed histories and conduct physical examinations to make appropriate decisions about which tests will be beneficial. ■

Important Terms

DEXA scan: Dual-energy X-ray absorptiometry, a procedure that measures bone mineral density.

hypertension: High blood pressure.

Questions to Consider

1. Explain the difference between relative and absolute risk. Which risk statistics give you more relevant clinical information for decision making regarding patient care and why?

2. What are the benefits of the routine screenings discussed in this lecture? What are the risks, if any? Discuss the difference between screening and testing.

Optimizing Health—Prevention

Lecture 7

Now let's talk about high blood pressure. … What we need for all of us is very, very aggressive surveillance. In other words, we need to just take people's blood pressure. It's very cheap. It's very easy. It's very accurate, and it's available. You can take your own blood pressure.

In this lecture, we'll look at some measures we can take to prevent illness before it starts. Prevention is always preferable to trying to cure an existing disease.

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Cigarrette smoking is one of the leading preventable causes of early death.

First, if you smoke now, you need to stop. Worldwide tobacco-related deaths exceeded 5 million per year in 2008 and are expected to reach about 8 million per year by 2030. In addition to the expected 220,000 new cases of lung cancer in 2009, smoking also causes cancers of the neck, tongue, larynx, esophagus, and bladder, along with heart attacks and strokes. There is no question that avoiding any exposure to tobacco smoke—firsthand, secondhand, and now, thirdhand—is the single most effective measure worldwide in terms of reducing this morbidity and mortality. Besides the loss of life and the morbidity, smoking imposes an enormous cost on our society. It costs the United States more than $200 billion a year in lost productivity and another $95 billion in health-care expenditures. If you're a smoker, the American Cancer Society and other organizations have many resources to help you stop.

A final word about smoking in relation to hypertension: Tobacco products increase sympathetic nervous system activity, which is the part of the nervous system that releases adrenalin. The resulting fight/flight reaction increases the oxygen consumption of the heart muscle, along with the heart rate and force of contraction. Over time, this causes stiffening of the arteries, which can last for decades. Stopping smoking can lower the risk of coronary artery heart disease by 33 percent in a relatively short period of time, even if you have smoked for a long time.

Much of the research dollars that we're spending on lung cancer alone today, in my opinion, would be much better spent if we could just get people to stop smoking or never start.

High blood pressure is known as the silent killer. As mentioned earlier, acceptable blood pressure is now about 120/80. If you have hypertension, reducing your salt intake can make a significant difference; it may be the only thing necessary to get your pressure back to a more acceptable level. Exercise, weight loss, changes in nutritional choices, and reduction of alcohol intake are also well known to reduce blood pressure.

Immunizations are also important in preventing disease and maintaining optimum health. About 50,000 Americans a year, mostly adults, die from vaccine-preventable diseases. Vaccines in adults could prevent about 80 percent of all influenza deaths, about 60 percent of deaths from pneumococcal infections, and 90 percent of hepatitis deaths. The National Immunization Program, which is primarily for children, has made tremendous gains in public health. Readily available vaccines for the general adult population include those for pneumonia, influenza, and shingles.

Interestingly, good dental care can be a factor in preventing heart disease, which can be caused by infections in the mouth. Of course, brushing, flossing, and getting regular dental checkups are preventive measures you can take in this regard.

Finally, hearing loss, which can be psychologically damaging, can be prevented by avoiding chronic exposure to high levels of noise. Treatment

for hearing loss includes hearing aids and surgery. Parents are especially urged to protect their children from trauma to the nerves within the ears by ensuring that MP3 players are turned down to appropriate levels. ■

Questions to Consider

1. List five reasons why quitting smoking will improve one's health.

2. What is the relationship between the frequency of cancer and aging? Name two cancers where age might be factor.

3. How have immunizations and vaccinations affected the human lifespan worldwide? Have the controversies that have arisen around these topics been resolved?

How We Look—Surgery and Skin-Care

Lecture 8

My concern is that [cosmetic] procedures are being overly used, especially in younger patients and even in children, as one more step toward some kind of perfection which they think will meet the ideals of others and, again, in the older patient, in pursuit of this idea of eternal youth.

This lecture looks at cosmetic procedures, which are designed to improve appearance, and reconstructive procedures, which aim to improve function. Reconstructive procedures include ones you're probably familiar with, such as cleft lip and palate reconstruction. A major reconstructive procedure may also be required after removal of a cancerous tumor or as after traumatic tissue loss.

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Patients seek out plastic surgery, such as breast implants, for cosmetic or reconstructive reasons.

Mamoplasty (reshaping of the breast) is among the most common reconstructive procedures. In augmentation mammoplasty, which is usually cosmetic, an implant is placed beneath the pectoral muscle to push out the chest wall. Reduction mammoplasty is performed for patients who have heavy breasts that cause back or neck pain. In postmastectomy reconstruction, the entire organ is reconstructed from tissues in the general area of the breast or other areas, such as the abdomen.

In 2007, 12 million cosmetic surgical procedures were performed in the United States. These included liposuction, rhinoplasty, eyelid surgery, and **abdominoplasty**. Many people who choose these treatments feel an enormous gain in self-image and confidence, but we must take care as a society not to overemphasize physical beauty and youth.

Facelifts offer excellent cosmetic results, but the procedure is not minor. Incisions are made along the face and behind the ear; the skin is then lifted up and dissected to detach it from surrounding muscle and nerves. Finally, the skin is pulled back and sewn up. The possibility exists for a high degree of blood loss in this area of the body. Rhinoplasty is another major procedure, requiring broken bones in the nose.

Botox is also a popular cosmetic option. This injectable substance comes from an organism called *Clostridium botulinum,* which produces the most deadly known toxin. Botulinum toxin acts on the neuromuscular junction, the point where nerves meet muscles, causing flaccid paralysis. Used cosmetically, it paralyzes the muscles that may have been pulling together a wrinkle, allowing the wrinkle to relax. Botox treatments have to be renewed about twice a year and are very expensive. Botox itself and artificial Botox can result in serious complications or death when the toxin migrates to other parts of the body.

Many people are concerned with cellulite, but it's important to note that there is no difference between normal fat and cellulite, and there are no medicines or creams that will magically remove cellulite. Liposuction is another popular way to remove fat, but reducing fat mass and weight in this way doesn't lower the risks associated with obesity.

The skin is our largest organ, and it may be one of the key things that drives people to plastic surgery. Exposure to the sun carries significant risks for skin damage and skin cancer. The best advice is to stay out of the sun as much as possible and use a lotion or spray with a sun protective factor (SPF) of at least 15 when you're outside. Another skin problem that affects both adults and teenagers is acne, which is basically a blocking of the sebaceous glands of the skin. Treatment may involve soap or astringents, topical drugs, and antibiotics taken by mouth. ■

Important Terms

abdominoplasty: Surgical removal of excess skin and fat to flatten out the abdomen.

mammoplasty: Surgical reshaping of the breast.

Questions to Consider

1. Discuss the physiology of the use of Botox for cosmetic purposes. What are the pros and cons of its use?

2. Why is proper skin care important at any age? At what age should you start taking care of your skin?

The End of the Journey—Death and Dying

Lecture 9

In a lot of cultures, old age is not seen as a curse. It's looked upon as a source of great wisdom, worthy of respect, and it's a different way of seeing the wisdom and the experience of age.

Our society tends to deny the fact of death rather than preparing for it. A few days before he died, the American novelist William Saroyan supposedly said, "Everyone has got to die, but I've always believed that an exception would be made in my case." We should start by admitting that there are no exceptions. In this course, we're exploring how to live better and healthier lives, but our goal is not to avoid aging or dying. It's to live the healthiest, most energetic lives we can and age with as much grace as possible.

Even professionals in the medical community have gotten caught up in what journalist Bill Moyers called "the rescue fantasies of our health-care providers." We think we can cure everything, and we're supported in that belief by the growth of technology that allows us to perform what we once thought were miracles. Doctors refuse to acknowledge failure, and we view the deaths of our patients as exactly that, our ultimate failures.

Trying to keep a diagnosis secret from a family member robs that person of important choices about treatment and about how his or her remaining life will be spent. In the end, the patient usually jumps to the worst conclusions. And even if the prospect of death is one of those conclusions, once it's a fact, it's somehow easier to accept. Despite this, even doctors are often reluctant to be fully open with critically ill patients.

Over the past few years, some wonderful programs have sprung up in hospitals to help patients face the challenges of a cancer diagnosis, especially late-stage cancers. The new field of **psycho-oncology** blends the psychological, emotional, and spiritual aspects of a cancer diagnosis with the patient's physical care. One of the original programs in this field was

founded at Sloan-Kettering by Dr. William Breitbart, who helps patients live out their remaining time with as much fullness and awareness as possible.

Breitbart's holistic perspective on death and dying is finally being embraced in Western cultures, but it is not new to many older, more traditional cultures. I think an understanding of death grows as cultures learn to appreciate old age. Furthermore, many societies deal much more directly with death than we do. These cultures understand the cyclical nature of life and death. Death is not seen so much as the enemy but as the natural outcome of life.

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The Western attidude toward death is to deny rather than prepare for it.

Two other important developments for patients and their families who are facing death are the hospice movement and palliative care. In the hospice movement, the emphasis is on helping people die with dignity and peace. Hospice focuses on relief of symptoms and on surrounding patients with friends and family members. Palliative care is basically treatment without any intention of cure. It might include, for example, home respiratory therapy to make breathing easier for a person suffering from lung cancer. Both of these approaches have shed new light and understanding on death and dying. ■

Important Term

psycho-oncology: A medical field that combines treatment of the psychological, emotional, and spiritual aspects of coping with a cancer diagnosis with the patient's physical care.

Questions to Consider

1. Discuss some of the programs established to help patients face the diagnosis of cancer.

2. What is hospice and what services does it provide? How does it differ from palliative care?

3. Discuss your concerns or fears about aging. What steps can you take to reframe your negative ideas?

Health Advances on the Horizon

Lecture 10

***FOXO3A* is ... the major contender if you're going to look at a single gene for longevity. ... It could, in years ahead, lead us to some real advancement in understanding the biology of human aging.**

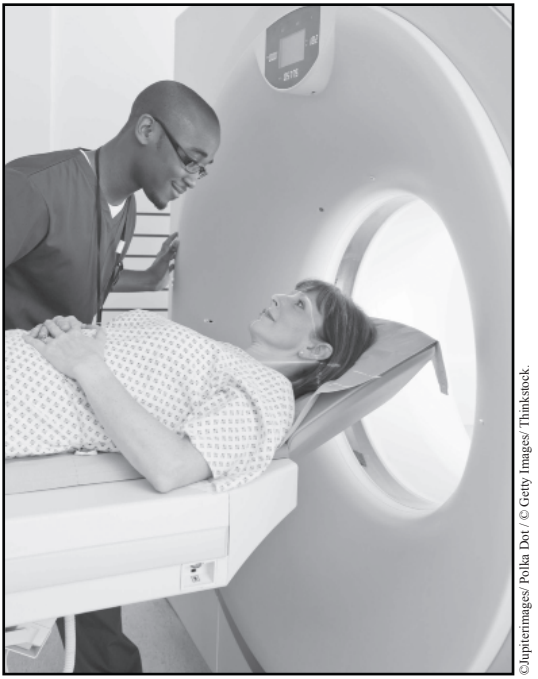
This lecture explores some advances in medicine and science on the horizon that may affect our longevity, health, and well-being. As we've seen, both longevity and quality of life have improved markedly since the era of our grandparents. We can now stay healthier and be more productive for much longer than was ever possible in the past.

Before we look forward, it's interesting to think about a few past advances in medical science that seem commonplace today, such as polio and smallpox vaccines and penicillin. In technology, **CAT scan** and MRI equipment, which produce detailed images of organs inside the body, once seemed the stuff of science fiction. **Laparoscopic surgery** has also been revolutionary, significantly cutting hospital stays and recovery time for common procedures.

As a general surgeon, when I had the exciting experience of being there at the very beginning of laparoscopic surgery, this, too, was something out of *Fantastic Voyage*.

Currently, research into the forkhead box (*FOX*) gene family holds clinical promise for longevity. This group of genes produces proteins called transcription factors that attach to specific regions of the DNA and regulate downstream activity. These genes are also responsible for the formation of many organs and tissues in the embryo; they affect the cell cycle, DNA repair, and apoptosis; and they regulate other genes directly, including those in the cardiovascular and immune systems. The FOX proteins receive environmental stimuli and translate them into gene-expression programs that can somehow increase longevity and may even promote tumor suppression. In the laboratory, upregulation of *FOXO* genes has dramatically increased

the longevity of worms and fruit flies. A related group of genes, ***FOXO3A***, seems to have a positive effect on human life expectancy.



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Many of today's common procedures once seemed the stuff of science fiction.

As we know, major connections have been found between chronic obesity and heart disease, adult-onset diabetes, and several cancers. One line of investigation related to obesity is the exploration of RNA interference. Inserting RNA into cells can inhibit the activity of selected genes. Researchers have been able to manipulate the genes of roundworms in such a way as to produce fat or thin specimens, which could have implications for treating patients who have a genetic basis for obesity.

Research with primates shows that a significant reduction in calorie intake, about 30 percent, results in a marked extension of longevity, a delay in the diseases of old age, and improvement in aspects of lifestyle. However, severe calorie restriction may not work for humans for a number of reasons. For example, such diets require compulsive structuring to maintain good nutrition.

In diabetes research, work is being done to develop an artificial pancreas; this will have a computerized pump to monitor and maintain normal sugar levels in the blood. Immune retraining of the body may also help people who

have **type 1 diabetes**, in which the immune system assaults the pancreatic beta cells in the islets where insulin is produced.

For patients who have **angina** and have had angioplasties, the possibilities of eluting stents are being investigated. Such stents release drugs continuously to prevent clotting. Another promising development is in biodegradable polymer technologies, which allow the delivery of doses and booster doses of vaccines in a single injection. Finally, adjuvants are additives that allow needle-free administration of vaccines, which can be particularly beneficial in trying to inoculate large numbers of children in foreign countries. ■

Important Terms

angina: Chest pain of cardiac origin caused by lack of blood flow.

CAT scan: Computerized axial tomography, a procedure used to identify disease or other abnormalities; a CAT scan machine uses computer technology to generate a three-dimensional image, or cross-section, of the body.

FOXO3A: A gene variation that appears to have a powerful positive effect on life expectancy.

laparoscopic surgery: Minimally invasive surgery using only a few small cuts into the body and an instrument through which interior structures can be seen.

type 1 diabetes: An autoimmune disorder in which the individual does not produce any insulin because the beta cells do not function; patients must take insulin throughout their lives.

Questions to Consider

1. What do you feel is the greatest medical advancement made in your lifetime? What advancement would you like to see made in the next 30 years?

2. What is the effect of severe calorie restriction (that is, a decrease of more than 30 percent of calories) on primates? Do you feel calorie restriction is a reasonable approach to lengthening life for humans?

Nutrition—Choices for a Healthy Life

Lecture 11

The two time-tested ways to attain optimal health without question are through healthy foods and nutrition and appropriate physical exercise or exertion. … These are going to achieve the most gain for the effort in almost all the aspects of getting to optimal health and good, healthy aging.

In the next few lectures, we'll look at general guidelines and specific suggestions for nutrition. As we do so, keep in mind our main themes for this course: moderation, the Goldilocks theory (choosing what's right for you), the idea that small changes can make a big difference, and the dictum "It's not nice to fool Mother Nature." Also remember that we will use the word "diet" in the sense of its original Greek meaning, "a way of life," rather than a weight-loss program.

In America, we're challenged by the culture of supersizing, fast foods, and an overabundance of processed foods, yet we've been saturated with false body images from the media. Our culture tends to be judgmental about people who are overweight, and we're judgmental about ourselves when we don't make our goals or manage to resculpt our images. To complicate the picture, we get mixed messages about food throughout our lives. As children, many of us were encouraged to clean our plates. Later, we're told, "Don't eat so much." In some cases, food is used as a reward or punishment. These mixed messages create mental and physical distress.

In 2006, the total cost for coronary **angioplasties** and coronary bypass operations performed in the United States was over $100 billion, but a large number of these procedures could have been avoided with basic changes in lifestyle. Furthermore, such changes can actually reverse some of the damage we've already done to ourselves. Nonetheless, some risk factors for heart disease are built into us. For example, cholesterol is introduced into the blood by two mechanisms: eating and production from the liver. The capacity of the liver to produce cholesterol is genetically determined and, in some people, may be tremendous. Today, people affected by

this overproduction can take statins to block cholesterol production in the liver.

In some places, nutrition and its diseases are a matter of poverty, but in the United States, many serious diseases—including diabetes, heart disease, and cancer—can be traced to nutritional excesses. Numerous studies have shown that African, Asian, and Hispanic populations, when acquiring the diets and habits of affluent Western cultures, almost immediately begin to acquire the same diseases.

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Nutrition-related disease may be linked to scarcity or to overabundance.

I believe there is too much focus on studying and separating out individual nutrient components in our culture instead of considering the benefit and value of the whole food. For example, a number of years ago, beta-carotene was found to be a potent antioxidant and became popular as a nutritional supplement. What people ignored, however, is the fact that there are hundreds of other carotenes in nature. Why isolate one chemical or one antioxidant property, when we can get them all by eating the whole food? Our goal is to try to find combinations that provide optimum nutrition.

There are many weight-loss diets with gross nutritional imbalances. No-fat diets, for example, make it hard to absorb fat-soluble vitamins and ignore the importance of healthy fats. Low-carb or no-carb diets simulate diabetes. The key is to find nutritional balance. In the next few lectures, we'll talk about the value of cooking at home, reducing the percentage of meat in your diet, and increasing fish, fruits, grains, and vegetables. ■

Important Term

angioplasty: A medical procedure performed to widen existing coronary arteries.

Questions to Consider

1. Discuss the differences between diseases of poverty and diseases of affluence.

2. What is meant by the term "nutritional balance"? Discuss what this means to you personally in the context of the Goldilocks criteria.

The Physiology of Nutrition

Lecture 12

In energy production … the final common denominator is almost always glucose. It's the most familiar carbohydrate, for example, and the diet which brings us [this consists of] breads, pastas, rice, beans, and a lot of the grains.

In this lecture, we learn how our bodies process foods and nutrients in foods. The key word here is "metabolism," which refers to all the energy processes in the body, including consumption, expenditure, and renewal. Metabolism can be divided into two processes: **catabolic reactions**, which break down molecules and release energy for use by the cells, and **anabolic reactions**, which consume energy and resynthesize cells or tissues.

These energy transfers rely on a common currency in our cells, a chemical called adenosine. This is a large molecule that has two or three phosphate radicals (ADP with two phosphate radicals; ATP with three). When the adenosine has three phosphate radicals, it can release energy by releasing one of the phosphates. Conversely, energy is required to convert the resulting ADP back into ATP.

There are seven major classes of nutrients, divided into two groups. The macronutrients are required by our bodies in large amounts. These are carbohydrates, fats, proteins, fiber, and water. The micronutrients—vitamins and minerals—are required in small amounts

Carbohydrates are organic molecules made up of long chains of carbon, along with hydrogen and oxygen. Common carbohydrates are broken down into two categories: simple and complex. Simple carbohydrates, such as glucose, are absorbed rapidly by the body. In body cells that require immediate energy, glucose is oxidized and burned to produce energy via the ATP and ADP + P pathway. Excess glucose can be stored in the liver and the muscles for future use as a molecule called glycogen. To get the glucose into the cell to work, we use the hormone insulin, which comes

from the islet cells of the pancreas and drives the glucose out of the blood and into the cell where it can be used.

Avocados contain healthy unsaturated fats.

Most of the fats in the body are triglycerides, which are made up of a backbone molecule called glycerol with three fatty acids attached. Transportation of fats in the body is performed by lipoproteins, which also carry cholesterol. Lipoproteins are arranged into groups by their physical density. **LDL** and very low–density lipoprotein (VLDL) are mainly in the body to transport the triglycerides from liver cells to fat cells, where they're stored. LDL delivers cholesterol to cells throughout the body for tissue repair, but excessive LDL can result in fatty plaque. HDL carries excess cholesterol to the liver for destruction to prevent its accumulation in the bloodstream.

The fats we eat are classified as saturated or unsaturated. Saturated fats and trans-fats, which are the worst for your health, are generally solid at room temperature, such as butter. Unsaturated fats tend to be liquid at room temperature and are healthy, particularly monounsaturated fats. These can be found in avocado, canola oil, and olive oil.

Proteins are basically made of chains of amino acids and are used in transportation and structural functions. The essential amino acids are those we cannot make in our bodies; we have to eat them. Fortunately, we can get all we need by eating plants or other animals that have eaten plants.

Any healthy diet includes low amounts of saturated fats, lots of fruits and vegetables, and lots of whole grains, and it's generally low in sugars, cholesterol, and salt. ■

Important Terms

anabolic reactions: Reactions that consume energy and are used to resynthesize compounds.

catabolic reactions: Metabolic reactions that break down molecules.

LDL: Low-density lipoprotein, fat protein that transports triglycerides from liver cells to fat cells, where they are stored; carries cholesterol in the blood and delivers it to cells throughout the body for tissue repair; and aids in the synthesis of vital chemicals, such as steroid hormones.

Questions to Consider

1. Discuss in as much detail as you can the conversion of ATP to ADP plus energy.

2. Discuss the functional and physiologic differences among HDL, LDL, and total cholesterol. Do you know your own LDL and HDL levels?

The Role of Vitamins

Lecture 13

A safe rule of thumb for me—if you want to look for some guidance—would be not to go over twice the daily RDA in your vitamin supplement in most cases. I'm speaking of supplements here, not the food. … You're generally safer getting almost all your exposure to vitamins in whole foods.

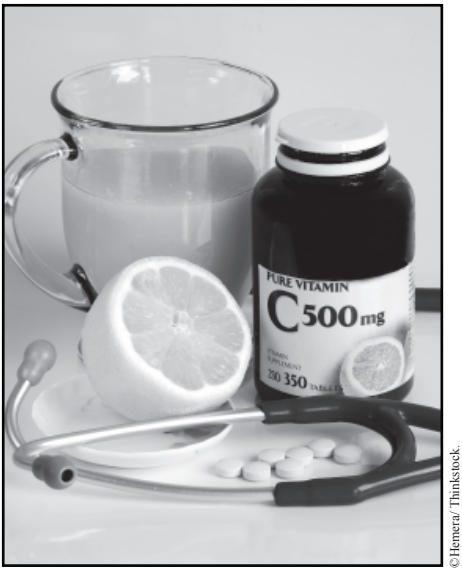
Vitamins are nutrients our bodies require from an external source because we cannot manufacture them ourselves. Vitamins are a group of 13 organic chemical compounds that are required for normal growth and development. Their functions include acting as hormone messengers (vitamin D), regulators of tissue growth and cell differentiation (vitamin A), and **antioxidants** (vitamins A, C, and E). A vitamer is one of two or more related chemical substances that fulfills the same specific vitamin function. Vitamin supplements are any or all of the 13 defined vitamins taken as a pill or injection. Supplements in general are taken to improve nutrition in areas where we are deficient.

Among the 13 vitamins, 4 are soluble in fat: A, D, E, and K. Those in the vitamin B complex and vitamin C are water soluble. Water-soluble vitamins are easily excreted, which means that regular intake is important. The fat-soluble vitamins require fats to transport them through the gastrointestinal wall so they can get into the bloodstream. The recommended daily allowances (RDA) refer to the average need for a healthy adult.

As far as we know, there is no scientific difference between natural and synthetic vitamins. But there is a difference in the fact that when you get most of your vitamins from foods, there may be other chemicals acting in synergy with the single vitamin.

The Women's Health Initiative Study followed 160,000 postmenopausal women over the course of eight years. Forty percent of the women in the study used multivitamins, but no association was found between multivitamin use and reduction in the risks of various cancers or the overall death rate.

Additional studies have shown that even moderately high doses of vitamin supplements can cause serious consequences. For example, high doses of vitamin E actually increased the risk of dying in patients with heart disease. High doses of vitamin C have been shown to offer no benefit for preventing common colds. In fact, a study published in the *Archives of Internal Medicine* found that there were no benefits confirmed for multivitamin consumption in 10 categories, including the prevention of blood clots, reduction in the risk of breast or colon cancer, and so on.



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Vitamin C in high doses does not assist in preventing common colds.

With a few exceptions, the vitamins and nutrients from whole foods are generally sufficient to prevent vitamin deficiencies. The exceptions include B_{12} injections sometimes given to elderly patients, folic acid given to pregnant women, and vitamin D plus calcium given to postmenopausal women.

If you feel you must take a vitamin supplement beyond what you're eating in a whole-food diet, then limit yourself to maintenance doses. Take a good-quality multivitamin and, perhaps, a mineral supplement without exceeding the RDA. Be aware, too, that infants and children need specialized vitamin care. Patients who are taking medication for heart disease or kidney disease, are on anticoagulants, or are on steroids should note that supplements can interact dangerously with many medications. Cancer patients should talk to their doctors about taking supplements. Finally, when you choose a supplement, look for some certification, such as the National Science Foundation International label or the Consumer Labs seal of approval. ■

Important Terms

antioxidants: Substances that may protect cells by neutralizing the free radicals that damage cells and tissue.

vitamins: Organic chemical compounds required by the body from external sources because they cannot be manufactured internally.

Questions to Consider

1. How is a supplement different from a vitamin? What purposes do supplements and vitamins serve, and can they be over- or underutilized?

2. Discuss the vitamin-related scientific trials covered in the lecture. Which had results that surprised you?

The Role of Supplements

Lecture 14

All the evidence points to the direction of relying on our food; capsules and supplements—absolutely do not rely on them. … Pig out on carrots, sweet potatoes, chard if you like it, asparagus, papaya, prunes, oranges—the whole vast array of foods that are delicious and are good for you.

In the last lecture, we talked about the differences between vitamins and supplements. In this lecture, we'll focus on nutrients and chemicals that when added to the diet might lower the risk for some health problems and might improve overall bodily function.

Dietary supplements do not need to be approved by the FDA, but it is illegal to advertise supplements as a treatment or cure for any specific disease or condition. Manufacturers can, however, make claims that the supplement aids or supports some particular function.

Antioxidants are one major category of supplements. As we've seen, **oxidation** reactions can create free radicals, which are part of normal host defenses but can also cause cell damage. Most of the time, our bodies can handle the free radical load, but excessive production can damage cells and cause **oxidative stress** (the elevation of free radicals beyond the body's capability to neutralize them). Antioxidants halt these chain reactions by neutralizing free radicals and their intermediates.

We have both internal and external naturally occurring antioxidants. Glutathione is one, along with vitamins C and E and numerous enzymes. Fruits and vegetables, whole grains, and nuts are dietary sources of antioxidants. The sources of destructive free radicals include ultraviolet and other forms of radiation, toxins, and pollutants. Free radicals contribute to the development of many diseases, but recent research suggests that megadoses of antioxidants taken as supplements cannot prevent heart disease or diabetes. Additionally, large doses may be harmful.

Oxidative stress plays a clear role in cardiovascular disease, but controlled studies with antioxidant supplements show no reduction in the risk of developing heart disease or in the rate of progression of the disease. If a diet rich in antioxidants is beneficial but supplements are not, what's going on? The theory is that other molecules in fruits and vegetables improve cardiovascular health in patients with diets high in these foods.

Calcium is the most abundant mineral in the body and is involved in muscle contraction and nerve conduction, among other processes and functions. Of course, calcium is used to prevent osteoporosis, but it has also been suggested that it may have value for cardiovascular health and cancer prevention. Conclusive evidence in this regard is not yet available. Vitamin D and magnesium may be prescribed with calcium. Calcium sources in food include dairy products, dark-green leafy vegetables, and nuts and seeds.

The message is, get as many of your antioxidants from whole foods, highly colored fruits and veggies especially, and don't megadose on the supplements.

Fiber is basically the indigestible part of plant food that creates bulk in the digestive system. It keeps the bowels soft and may help eliminate toxic wastes. Some soft evidence suggests that fiber may offer some protection from heart disease, reduce the risk of colon and breast cancer, and reduce blood sugar in diabetics. I recommend drinking about a tablespoon of powered psyllium in berry juice daily as a fiber supplement.

Herbal supplements are those derived from plants. Common ones include ginkgo biloba, ginseng, and echinacea. Very little science backs up the claims of these supplements. Again, many legally sold dietary supplements are not required to obtain FDA approval for safety or effectiveness. Furthermore, many supplements have serious lethal potential when taken in large doses or with prescribed drugs. ■

Important Terms

fiber: The indigestible part of plant food (roughage) that creates bulk in the digestive system. It absorbs water and promotes defecation; may aid in eliminating toxic wastes.

herbal supplements: Supplements derived from plants.

oxidation: A process whereby electrons are transferred from one molecule or atom to another, creating free radicals. Free radicals and oxidation reactions are a necessary part of normal host defenses, but excess oxidation reactions are damaging.

oxidative stress: The elevation of free radicals beyond the body's capability to neutralize them to safe levels. Excessive oxidative stress damages the cells and tissues, specifically the mitochondria.

Questions to Consider

1. Do you take supplements or vitamins? If so, why? If not, why not?

2. What are antioxidants, and why do they matter to your health? What are some natural food sources that are high in antioxidants?

Whole Foods for Optimum Health

Lecture 15

It's a very common question I get—whether or not the intensity of the color in the food relates to the power of the various nutrients. The answer is no. Only a few of the many nutrients give a color to the food. Others that are still very important don't impart any color at all.

This lecture looks at some of the whole foods that are of particular value for us when we're aiming for optimum health. But remember, these are just a few of the hundreds of whole foods that should contribute to a healthy way of eating.

As mentioned earlier, **mitochondria** are organelles inside cells that are the home of energy production. Mitochondria are also the major producers of free radicals and become major targets of oxidative stress. One of the more controversial issues today is the role of the antioxidant polyphenol molecule resveratrol in reducing oxidative stress. Resveratrol is found in grape skins, grape juice, and red wine. In the laboratory, resveratrol supplements extend the lifespans of mice, but no reliable studies of its effects on humans have been performed. Another group of molecules called sirtuins have been implicated in the regulation of aging, transcription, apoptosis, and stress resistance, but again, research on sirtuins is in its infancy.

Large amounts of polyphenols are found in grapes and red wine.

Polyphenols are organic chemicals that belong to a family of several thousand compounds referred to as flavonoids. They're found in large amounts in fruits, berries, pomegranates, grapes, wine,

walnuts, olive oil, chocolate, cocoa, coffee, and tea. Their antioxidant properties can reduce the risk of cancer and cardiovascular diseases.

How do we get the benefits of these molecules that are in food without going into an area of unproven claims and possible risks? The answer is whole foods. There is a great deal of debate about eating organically grown foods versus eating foods that may have been treated with pesticides and other chemicals. My position is that these chemicals are very harmful to our health, especially to the health of children.

As a group, berries are packed full with beneficial nutrients, including resveratrol and the sirtuins, but note that nonorganic berries tend to be grown using many chemicals. Blackberries, raspberries, elderberries, strawberries, and açai berries all contain, among other compounds, anthocyanins, which are powerful antioxidants. They appear to inhibit cancer development by several mechanisms, including minimizing DNA damage. They also reduce inflammation, slow the growth of premalignant cells, and inhibit tumor angiogenesis (the growth of new blood vessels in tumors).

Phytochemicals, meaning those from plants, protect against breast, colon, and liver cancer in the laboratory. In apples, these anticancer properties are primarily concentrated in the peel, but again, choose organic if possible because pesticides tend to stick to the waxy skins of apples. Plums, both fresh and dried, are also high in antioxidants and are effective in neutralizing superoxide radicals, which result in oxidative stress. Concord grapes and grape juice offer the broadest range of polyphenols and the highest overall antioxidant concentration capacity.

Both allicin in garlic and curcumin in tumeric are antioxidants and anti-inflammatories. Recent studies suggest that allicin may reduce atherosclerosis and fat deposition in the blood vessels and improve lipoprotein balance.

Finally, **probiotics** are active bacteria found in yogurt and yogurt-like foods and are sold as supplements. Their active bacteria are good for you, but there's no evidence that these bacteria are any better than the bacteria that are already present in the colon. ■

Important Terms

mitochondria: The cell's powerhouses and the source of energy in the engines of the cell.

polyphenols: Common antioxidant molecules found in nature that may inhibit LDL oxidation and, thereby prevent arterial plaque formation.

probiotics: Active bacteria added to foods to promote digestive health; they can be found in yogurt.

Questions to Consider

1. What are anthocyanins? What is their function in the body? What is a food source for them?

2. What are the pros and cons of taking megadoses of a chemical, such as resveratrol?

The Good Fats

Lecture 16

Read the labels. Look for the sources. Ask good questions. Become an educated consumer. … A lot of the changes have occurred because of people like you going out and demanding cleaner, safer food and good knowledge of the sources.

According to general dietary recommendations, your total fat intake should be kept below about 30 percent of your daily calories. In a 2,000-calorie diet, that would mean less than about 650 calories of fat. Of that fat, less than half of it should be saturated fat.

Fatty acids are **organic** acids composed of a chain of carbons and multiple hydrogens attached to those carbons. Unsaturated fats break down into monounsaturated and polyunsaturated fats. The latter include an important group called omega fatty acids. The omega-3 fatty acid group is found in coldwater fish, such as herring, salmon, mackerel, tuna, and so on. High consumption of the omega-3s has proven positive effects, particularly with regard to cardiovascular disease. A small amount of **omega-6 fatty acids** in the diet also promotes good health, but an overabundance is unhealthy. Omega-6s are found in red meat and various vegetable oils.

In general, both groups—the omega-3s and the omega-6s—have positive effects on health if eaten in the right proportions. Most scientists believe that human beings evolved and prospered on a diet with a 1-to-1 ratio of omega-6s to omega-3s. Our modern diet tends to have a ratio of about 15 to 1. We have a huge excess of omega-6 fatty acids in our diet, primarily because of processed foods. The maximum healthy ratio is probably less than 4 to 1.

Studies show that the 4-to-1 ratio or below yielded about a 70 percent decrease in total mortality from cardiovascular disease over higher ratios. The omega-3 fatty acids from fish or fish oil supplements significantly decreased blood triglyceride levels, which are associated with heart disease. Omega-3s may also prevent age-related macular degeneration, reduce joint tenderness in patients with rheumatoid arthritis, reduce cognitive decline

and dementias, and have many other positive effects. The omega-6 fatty acids, in low or normal levels, positively affect brain function, body growth and development in the young, and many functions in the clotting system. But high levels of omega-6 are associated with heart attacks, strokes, arthritis, and even mood disorders.

Eggs, milk, and cheese are sources of saturated fats.

Saturated fatty acids come mainly from sausage, bacon, cakes and cookies, chocolate, cheese, eggs, and milk. If possible, replace **saturated fats** with monounsaturated fats, such as olive oil, nuts, avocados, and so on. These will decrease LDL cholesterol and triglycerides and maintain high HDL cholesterol.

Polyunsaturated fats can be found in vegetable oils, coldwater fish, nuts of all kinds, and sunflower seeds. Cross-cultural studies show that inhabitants of the countries that surround the Mediterranean seem to gain some protection against heart disease from the large quantities of monounsaturated fats they consume in their normal diet. Eating a handful of mixed nuts daily has also been shown to reduce symptoms of heart disease.

Remember, the quality of the fat is more important than the total fat in the diet. When you can, substitute vegetable fats for animal fats. Substitute fish proteins for animal proteins. Replace whole milk with skim milk or 2 percent milk. Eliminate solid margarine, commercially baked goods, and deep-fried and fast foods to reduce the consumption of trans-fatty acids. ■

Important Terms

omega-3 fatty acids: Highly unsaturated fats needed for the production of hormone-like compounds known as prostaglandins.

organic: Biologic compounds or molecules found in nature that have a carbon base; also, plant and animal products defined by a particular method of farming that uses no chemical pesticides and no chemical fertilizers.

saturated fats: Long carbon–fatty acid chains that have no double bond because the whole molecule is saturated with hydrogen ions.

Questions to Consider

1. Define monounsaturated, polyunsaturated, and saturated fats. How do they each affect health in humans? In what food sources would you find these fats?

2. What are some ways you can increase the good fats and reduce the bad fats in your diet?

Sugar, Salt, Allergies, and Additives

Lecture 17

The consumption of added refined sugars is always terrible, and they wreak havoc in our diets. This is one area where you really do have control. You can make changes in the kinds of sugar you eat and the amount of sugar you eat. You'll receive huge health benefits from it.

This lecture looks at some foods and our responses to them that are not always optimally healthy. We'll start with sugars. As with fats, there are good sugars that are vital to our well-being, and there are bad sugars that, in overabundance, are the source of poor health. Again, as with fats, we come back to quality and quantity. The natural sugar in fruits, when eaten proportionally with other healthy foods, is quite beneficial.

A useful measure of sugar in foods is the **glycemic index**, which ranks carbohydrates based on the rate of conversion of the carbohydrate to glucose inside the body and its entrance into the bloodstream. The glycemic index is an arbitrary scale of 0 to 100, with pure glucose given a value of 100. The relevance to us is that spikes or rapid drops in blood glucose levels are unhealthy. A rapid rise in blood glucose causes an outpouring of insulin from the pancreas, which in turn can send blood glucose levels back down in a rapid overreaction. Over many years, this can lead to insulin resistance and, eventually, type 2 diabetes. Evidence seems to point to a strong correlation between high-carbohydrate diets and the development of insulin resistance.

Exercise definitely benefits long-term lowering of the blood pressure.

Some studies suggest that fructose is no better as a simple sugar than glucose is and may, in some ways, be worse. One study found that the fat gained from too much fructose has a tendency to be deposited in the organs inside the abdomen and around the belly, while glucose-generated fat tends to be stored under the skin. Research also suggests that it is dangerous to have more fat around the middle than lower in the body.

The abnormalities of blood chemistry related to the overuse of sugar are part of what's called metabolic syndrome. This is medically defined as the presence of at least three of the following factors: abdominal obesity or central obesity, high blood pressure, high triglycerides in the blood, low HDL cholesterol in the blood, and high blood glucose. It's estimated that about 25 percent of the world's adult population has metabolic syndrome. The solution is to minimize or eliminated refined sugar and maximize foods that are high in fiber and protein.

Another significant threat to our overall health is salt. The body seeks to reduce excess sodium by retaining water and filling the blood vessels too full, which elevates blood pressure. About 25 percent of all Americans have high blood pressure, and another 25 or 30 percent are considered prehypertensive. Reducing sodium intake, minimizing meat consumption, reducing alcohol, increasing fish intake, and decreasing caffeine can all help reduce blood pressure.

Food allergies are unexpected and unintended reactions that can be caused by even small amounts of a particular molecule. Common allergenic foods include dairy, eggs, nuts, seafood, tomatoes, and wheat. Preservatives and additives in food also cause problems for many people. Food sensitivities and intolerance are not related to the allergic immune-mediated response. The general advice for allergies, intolerance, and sensitivities is to read food labels carefully.

Finally, there is no evidence that detox of any kind works. Enemas, laxatives, diuretics, and transdermal detox pads have no value at all. ■

Important Terms

food allergies: Unexpected, unintended reactions to various foods or substances in foods.

glycemic index: A numerical index that ranks carbohydrates (on a scale of 0 to 100) based on the rate of conversion of the carbohydrate to glucose inside the body and its entrance into the bloodstream.

The Physiology of Weight Management

Lecture 18

There is no doubt in my mind that physical inactivity is dangerous across the majority of health and risk factors. Just as important, activity and exercise are beneficial across all risk and health factors. Moderate levels of obesity are not nearly as detrimental when compared to inactivity.

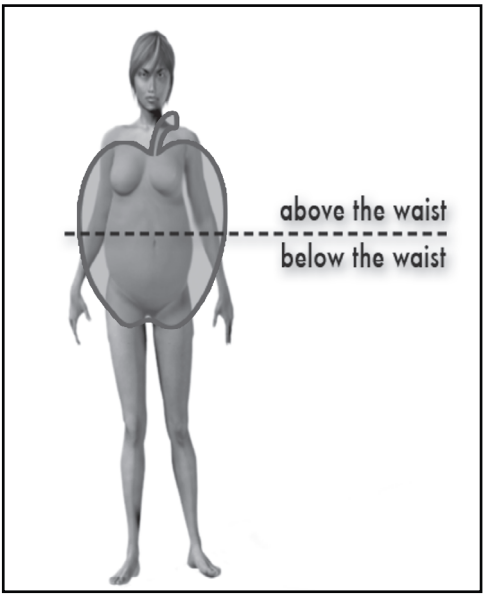
Obesity is one of the fastest growing disease epidemics in our country. The CDC estimates that about 66 percent of Americans fall into the overweight category, and 33 percent are considered severely obese. Obesity is the third leading preventable cause of death in the United States, behind smoking and high blood pressure.

Will power is not the answer to weight control. Genes help establish the body structure, and the brain and body physiology fight to defend that structure. The body's drive toward stable weight maintenance is very efficient, which is why dieting alone rarely succeeds. The BMI is the most standardized measure of weight. It's calculated by multiplying weight in pounds by 703, then dividing by height in inches squared.

Humans have evolved hundreds of genes to stave off starvation. When you go on a diet, the body responds first by lowering its metabolic rate to try to stop weight loss. This is why dieters generally experience a plateau after losing a few pounds. The metabolism has been processing 2,000 calories a day, but if you cut out 500, the body will reset its own metabolic level down to 1,500. Hunger signals will also increase.

Interestingly, how your body burns calories can be influenced by the geographical origins of your ancestors. The genes of people who have ancestors from cold environments have adapted so that their bodies use fewer calories to make more heat. Australian Aboriginal cultures had to evolve using calories from the very few edible fats and proteins in their environment. The good news is that it's not impossible to fight nature in this regard.

Excess weight distribution by body shape is critical and is also highly determined by genes. People with **apple-shaped bodies** (weight concentrated around the waist) are at increased risk for diabetes, heart disease, high blood pressure, and stroke. An expanded waist size reflects total and intra-abdominal fat, which for some reason is metabolically more active. It can move to other parts of the body, such as the arteries.



People with apple-shaped bodies store fat in their midsections, above and below the navel.

A number of studies suggest you don't have to be thin to be healthy. Even people who are as much as 20 pounds over normal weight can be fit and healthy, and it may be better to accept some degree of overweight than to subject yourself to yo-yo dieting.

Spot reducing, fad diets, and special weight-loss suits don't work. The key is to gradually make permanent, sustainable lifestyle changes. Add more fruits and vegetables to your diet, supplemented with nuts and other healthy snacks. Eat until you are no longer hungry rather than until you're full, be aware of portion sizes, and eat slowly. Eat a substantial breakfast, a slightly lighter lunch, and an even lighter dinner. Movement is an absolute must to counterbalance your body's efforts to thwart weight loss.

For morbidly obese people, bariatric surgery may be necessary. This involves either stapling the upper portion of the stomach, creating a very small pouch for food, or bypassing much of the small intestine where food absorption takes place. Both these procedures have some good results for people who are desperately at risk, but they also carry their own dangers. ■

Important Terms

apple-shaped body: A body shape with more weight around the waist than around the hips.

Questions to Consider

1. Name five health-threatening conditions associated with obesity.

2. Explain why a low-calorie diet may work for weight loss in the short term but not in the long term.

Healthful Eating versus Fad Diets

Lecture 19

You can think of the Mediterranean diet as a template or a model into which you can put almost any regional or ethic foods you might prefer. You can tailor this way of eating to any taste because it's sustainable, healthy, and delicious.

In this lecture, we'll review some of the points we've covered about nutrition, but first, we'll look briefly at exclusion diets. Low- or zero-carbohydrate diets replace carbohydrates with proteins and fats. The zero-carb diets work by forcing you into a diabetic-like state. The energy production from glucose takes a minimum of about 100 grams of carbohydrates. Without this, the body switches to burning fat, the byproducts of which are not as clean as those from glucose, water, and carbon dioxide. In extreme cases, these byproducts—called ketone bodies—can cause serious illness and even death from acidosis.

Low-fat diets are also popular. If you lower fat intake, you're going to lower calories because fat has twice the caloric value per gram than proteins or carbohydrates have. But the body can interconvert most nutrients and make exactly what it needs or wants; it won't follow your diet. Selective restriction of any of the main macronutrients—protein, fat, and carbs—will not fool the body.

When we apply our definition of diet as a way to live, the **Mediterranean diet** comes out on top. The Mediterranean way of eating and the foods it contains didn't originate from scientific research or in a laboratory setting. It was discovered by observations pointing to a variety of cultures where the diets were similar and the people more often live long, healthy, and active lives.

In the countries bordering the Mediterranean Sea, the basic foods include fruits, vegetables, and whole, unprocessed grains, which are all loaded with beneficial antioxidants, polyphenols, and fiber. Moderate amounts of low-fat dairy products are also included, along with olives and olive oil and small

quantities of nuts. The total fat in this diet is 25 to 35 percent of calories, which is not particularly low, but the saturated fats are 8 percent or less of total calories. The Mediterranean diet also includes moderate amounts of protein in the form of fish and poultry, beans, eggs, and very little red meat; virtually no processed foods; and very little sugar. Researchers everywhere conclude that this kind of eating offers significant protection from overall mortality. In addition to the USDA's food pyramid, other pyramids show clearly how other cultures can have the same macronutrient proportions as the Mediterranean diet in their own local foods. For example, the Latin American pyramid includes corn, beans, tubers, and whole grains. All the pyramids eliminate trans-fats.

The Mediterranean diet is a template into which you can fit a variety of delicious, healthy foods.

Other suggestions for making your diet healthy include eating frequent, smaller meals; controlling portions; and eating breakfast. Eat as low on the food chain as possible, which translates to vegetables and fruits. As Michael Pollan said in his book *In Defense of Food*, you shouldn't eat anything that your great-great-grandmother wouldn't recognize as food. You should also avoid food products that come bearing health claims, as well as foods with unfamiliar, unpronounceable ingredients; more than five ingredients; or high-fructose corn syrup. Eat mostly plants, especially their leaves, where a good deal of nutritional content is concentrated. Eat all meals at the table, and don't buy your food from the same place you where you buy fuel for your car. ■

Important Term

Mediterranean diet: A heart-healthy diet inspired by eating styles in Mediterranean countries that emphasizes the consumption of healthy fats, fruits, vegetables, and fish, with alcohol taken in moderation.

Questions to Consider

1. What are some of the dangers of a low- or no-carbohydrate diet?

2. Define the Mediterranean diet. What are the chief components of such a diet? How can the principles of this way of eating be incorporated into the diets of other ethnicities?

3. What are the advantages of a diet high in fruits and vegetables?

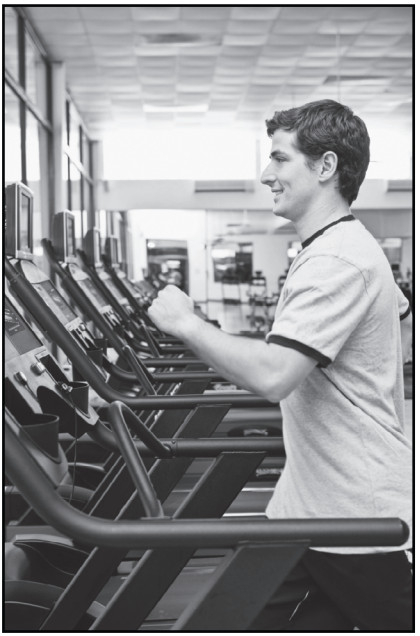
Movement and Recreation—a.k.a. Exercise

Lecture 20

For [people in long-lived populations], exercise was an integral part of what they did every single day, just being in the world. They don't have gyms. They don't have exercise programs. There's no equipment. They just got out and worked their bodies and moved. … It doesn't matter how we move. We just need to move.

Moving our bodies and making exercise a priority is one of the keystones to good health and longevity. For many people, however, exercise is work. A better approach is to think of it as play or recreation. Ideally, exercise should be a byproduct of something else you enjoy doing, such as gardening, biking, swimming, or hiking. For most of us, the how and what of exercise changes as we age, but it should always be part of our lives.

The main physical benefits of exercise include increases in strength in muscles, bone, ligaments, and tendons; endurance; flexibility; and balance. Side benefits include weight control, improvements in the **serum lipid profile** (exercise raises HDL cholesterol), and reduction in blood pressure. Exercise can also reverse and possibly prevent type 2 diabetes. Exercise stimulates brain cells and tends to make people more relaxed. It creates opportunities for social connections and for connection with nature. In addition, exercise increases the muscle-to-fat ratio,



Excercising daily is a key factor in maintaining good health.

which increases **aerobic capacity**—the maximal oxygen intake when exercising. As the muscle-to-fat ratio improves, so does glucose tolerance and insulin sensitivity.

People often worry about the dangers of exercise, but the absolute risk for a serious cardiac event during exercise is very low. The vast majority—96 percent—of all heart attacks occur while at rest. Nonetheless, if you have been inactive, you should consult your doctor before starting an exercise program.

If you have not been active, where do you begin? You might start with some basic personal measurements, such as your **resting pulse** rate, which is a good indicator of fitness in general. The average person's runs around 70. The other measurement to look at is **recovery time**. Take your pulse after really strong exertion, then see how long it takes to return to under 100. You can also time how long it takes you to walk a mile.

When you start an exercise program, decide what your goals are and set realistic routines. You may want to run in a marathon or you may just want to get a better night's sleep. These are both legitimate goals. You should also consider your work schedule and other commitments you have during the day.

We can all approach exercise, nutrition, [and] mental health as a buffet ... rather than a fixed menu.

It's well established that even moderate-intensity exercise will benefit cardiovascular health, but what's moderate for some people may be intense for others. The intensity of exercise should be based on your personal level of fitness. In general, brisk walking at a pace of 3 to 4 miles an hour for 30 to 60 minutes is considered moderate. Choose exercise that's easy to sustain in this moderate range and that involves the body's large muscles and a constant, rhythmical motion. You should also try to find ways to increase physical activity and energy output in your daily routine. Park far away from the mall entrance and use stairs instead of an elevator. Try to find a way to move your body almost every day, even if it's

only a little bit. Then, at least three days a week, include some strenuous activity that gets your heart rate up and gets you sweating. ■

Important Terms

aerobic capacity: The maximal ability of an individual's body to consume oxygen during physical activity.

recovery time: The rest period after exercise that is essential to muscle and tissue repair and strength building.

resting pulse: The resting heart rate measured immediately after waking up in the morning and before getting out of bed.

serum lipid profile: A blood test to determine risk of heart disease; measures levels of cholesterol, HDL, LDL, and triglycerides.

Questions to Consider

1. Name at least five proven physiological and mental benefits of regular aerobic exercise.

2. What is aerobic capacity? How can we maintain and enhance aerobic capacity as we age?

The Physiology of Muscle

Lecture 21

When you think about it, [muscles] are also there to convert your intention—the idea in your brain—into purposeful movement. You almost never are actually thinking about it, but when you reach out to grab something, you've gotten a command, an idea that's in your conscious. You've converted that into movement that allows it to happen.

The human body has nearly 700 individual skeletal muscles. Their function is to enable movement and maintain stability by acting as levers—sometimes even with pulleys (bones in the skeletal system)—in the body. The body has three kinds of muscle: skeletal, or striated, muscle; cardiac muscle; and smooth muscle. Tendons, which are made of dense connective tissue, connect the muscle to the periosteum—the covering of the bone. Ligaments connect bone to bone, not muscle to bone. The bursa are smooth, fluid-filled sacs that allow frictionless movement at or near a joint.

Muscles are tremendously supplied with blood because they are heavily involved in energy use. They burn a good deal of glucose and oxygen, and they produce a lot of waste products. Therefore, we need tremendous blood supply and an extensive capillary network in the muscle.

Muscles are innervated by motor neurons, which stimulate muscles to contract. A motor unit is composed of a single motor neuron, or nerve, and the muscle it supplies. These units can vary from one nerve going to 10 muscle microfibers to as many as 2,000. When a motor neuron fires, all the fibers in that unit fire together. With fewer muscles per neuron, finer movement is possible, but the movement is usually weaker.

In talking about levers, we look at three components: strength of movement (mechanical advantage), speed, and range of movement. All three cannot be great at the same time. In other words, you can't get mechanical advantage without sacrificing speed and range of movement. We have three kinds of levers in our bodies, with muscles to move them. The most important first-

class lever (akin to a lever and fulcrum) in the body is the head. The head is pulled up by the muscles of the neck using mechanical advantage. A second-class lever (akin to a wheelbarrow) is the calf muscle. Most of the levers in the body are third-class levers (similar to a catapult). These third-class levers allow us to gain speed at the expense of mechanical advantage so that we can throw things or run harder and faster.

Muscles are tremendously supplied with blood because they are heavily involved in energy use. They burn a good deal of glucose and oxygen, and they produce a lot of waste products.

Three basic categories of skeletal muscle are important in sports medicine. Type I, or slow twitch, fibers are postural muscles; they use oxygen for energy and are fatigue resistant. Type IIA fibers are fast twitch; they are typical of a sprinter's muscles in track. Type IIB fibers, fast twitch B, are for explosive bursts of energy. They do not use oxygen but fatigue easily. Most muscle groups are mixtures of more than one type of fiber in varying proportions. These proportions can also change, for example, in an athlete who goes from sprint to steady-state training.

Most exercises incorporate both **isotonic** and **isometric** muscle contraction. Isotonic means the same tone or the same tension. Isometric is an increase in muscle contraction without any increase in muscle length. The most common type of contraction is concentric, when the muscle shortens. The other type is **eccentric**, which takes place when the muscle is trying to lengthen against the force you're holding. Eccentric contraction is very effective in building muscle, but it can also cause soreness or injury. ■

Important Terms

eccentric contraction: An elongation of the muscle in response to a force—a "negative" motion.

isometric contraction: A muscle exercise in which the muscle is not lengthened.

isotonic contraction: A muscle exercise in which the tension on the muscle stays the same despite a change in muscle length.

Questions to Consider

1. What is the difference between a tendon and a ligament? Elaborate on the structure of each. How do they differ from muscle?

2. What kind of lever is most common in the human musculoskeletal system? What is the evolutionary explanation for its development?

Resistance Training and Weight Training

Lecture 22

A lot of people are very uncomfortable walking into one of the real heavy-duty gyms for the first time and confronting a room full of people with big muscles and tank tops, seeming to have a clear advantage over them as beginners. None of this needs to be true.

Muscle groups are strengthened when you push them beyond your comfort level to the point of microinjuries—small tears in the fibers, microfiber overuse, and cellular distress. The muscles then begin to repair and build strength, endurance, and bulk. This is called **hypertrophy**. **Weight training** stresses the muscles in a good way, if it's done carefully.

As we saw in the last lecture, concentric exercises decrease the angle between two bones as the muscle shortens, for example, as you do a curl and your bicep pulls your hand toward your shoulder. Eccentric exercises ("negatives") are the ones that allow the angle to increase; for example, when you are lowering a barbell, the angle increases between the upper and lower arm. The muscle is relaxing and lengthening, but it's actually trying to contract little by little. It's those intermittent contractions and relaxations that violate natural muscle physiology and can cause microinjuries or worse. The combination of eccentric and concentric contractions produces a greater increase in strength than concentrics alone.

Weight training strengthens and builds muscle through overuse, a process called hypertrophy.

Resistance training is a generic term for weight training. Other types of exercise included in this category are **calisthenics**

and workouts with free weights or Nautilus-type machines. With calisthenics, gravity provides the resistance. Doing calisthenics is effective, but it's also difficult to work certain muscle groups without equipment. With free weights, beginners may have difficulty isolating muscle groups and correctly performing the exercises. Weight machines are useful for beginners because they isolate muscles correctly. The range of motion and pivot points when you're using machines are well defined. Elastic resistance bands are excellent for working on specific muscle groups that are hard to train with weights. Free-motion machines, which offer a combination of the benefits of machines and free weights, are becoming popular. They provide tremendous flexibility in the range of motion, incorporating core strength and stability exercises, as well as some aerobic gain.

For slow-twitch muscles, you generally want more repetitions and lighter weight. For fast-twitch muscles, you want fewer repetitions and heavier weight. Always use a spotter if you are working with heavier weight loads. Older athletes should focus on an increased number of repetitions and lower weight. This type of exercise tends to benefit the ligaments and tendons more than muscle strength, offering protection from some of the common injuries of aging.

Beginners usually start with a simple set, which is a certain number of repetitions of an exercise performed three times. For example, you may do 10 curls as one set. The load you should use is about 60 percent of your one-repetition maximum. If you can lift 100 pounds once with failure, you use 60 pounds and try to get 10 repetitions. With the pyramid approach, you change the load and the number of repetitions as you go to the next set. Weight training should be done about three times a week or, at most, every other day.

The best kind of stretching to perform is **dynamic stretching**, which is moving continuously in the direction of your planned motion. If you're going to be running, for example, you want to take long, slow steps. If you perform static stretching—for example, bending over and touching your toes—stay in the position for at least 20 to 30 seconds so that your muscles can relax. ■

Important Terms

calisthenics: A system of body exercises; the term is a combination of words meaning “beauty” and “strength.”

dynamic stretching: Stretching that uses speed, momentum, and active effort to exercise the muscle.

hypertrophy: An increase in mass or girth. For example, exercise can cause hypertrophy in muscle tissue.

resistance training: Strength training that uses weights or other forms of resistance, such as elastic bands.

weight training: The practice of lifting weights or pushing against resistance to build muscles.

Questions to Consider

1. Why is weight-bearing training essential to a complete exercise program?

2. Define and describe eccentric muscle contraction as opposed to concentric muscle contraction.

Aerobic and Anaerobic Exercise

Lecture 23

Use your arms when you [exercise], and you'll get more benefit. On the other hand, you have enormous muscle groups and mass in your lower body. Therefore, running burns a lot of calories just from the sheer muscle bulk that's being called into play to work for you, but you generally can't go on as long.

Aerobic exercise is defined by a moderate level of exertion. It includes running, walking, and swimming—any body movement that increases your heart rate and your breathing rate and depth to a moderate level. Generally, this level allows you to carry on a conversation while exerting yourself.

In aerobic exercise, glycogen is metabolized into glucose, and the glucose is burned with oxygen to generate energy in the ATP process. When the glycogen and glucose start to become depleted, the system must convert to using fat for energy generation, which is inefficient, slow, and results in decreased performance and a buildup of lactic acid and ketones. It's what marathoners describe as "hitting the wall."

Anaerobic exercise is defined by fast-burst, high-intensity exertion. The exercise itself isn't necessarily any different, but the intensity is raised. Now your body is producing energy through glycolysis, in which glycogen is consumed in the absence of oxygen. This is much less efficient than aerobic exercise.

Cardiorespiratory capacity is a measure of the ability to extract oxygen in our lungs from the atmosphere and utilize the oxygen that's circulating in the blood. The specific measurement is called VO_2 max, which is the maximum volume of oxygen consumption during high-level exertion.

Aerobic training improves respiratory capacity, heart function, and muscle strength and decreases blood pressure and stress. However, when you're performing either aerobic or anaerobic exercise, you must pay attention to

your body. If you feel pressure or pain in your chest, arms, jaw, neck, or face, stop exercising and get help.

Aerobics doesn't increase your metabolic rate as much as exercises that build muscle, such as weight training. The basal metabolic rate (BMR) is a measure of how fast you burn energy while resting. Aerobics burns many calories during exercise, but it doesn't have a high afterburn rate.

Exercise is absolutely the single most consistent factor in staving off cognitive decline that occurs with aging.

Maximum heart rate and one-minute recovery times are good measures of anaerobic conditioning. To calculate your maximum heart rate, subtract your age from 220. During aerobic exercise, aim for about 80 percent of the maximum. In general, avoid training hard more than three times a week or every other day.

Non-weight-bearing exercises include those in which you're not working against gravity, such as swimming or cycling. Weight-bearing exercises include walking, running, and lifting weights. You generally burn more calories and expend more energy with weight-bearing exercises. Walking may be a better exercise for many people than running because walkers may be able to sustain their activity more consistently and for a longer period of time than runners.

Periodization helps to avoid overtraining and staleness. In this approach, you vary the amount, intensity, and kind of training you perform. The goal is to work toward moderate-intensity exercise five days a week for about 30 minutes or longer and high-intensity exercise three days a week for about 20 minutes or longer.

With **high-intensity interval training**, you push yourself to your limit for a specific, short period of time; then you rest for another short period of time. These short, intense workouts are intended to increase fat burn and aerobic conditioning. Be sure to get a doctor's approval and, perhaps, work with a trainer when starting this method. ■

Important Terms

anaerobic exercise: Fast-burst, high-intensity exercise used to build strength and muscle mass.

cardiorespiratory capacity: Ability of the heart and respiratory system to work together to generate energy.

high-intensity interval training: A form of training that involves short intervals of maximum-intensity exercise.

Questions to Consider

1. What is high-interval intensity training? How is it different from aerobic training?

2. Discuss the benefits of walking versus running as a form of exercise.

Exercise in Dealing with Injury and Disease

Lecture 24

The other thing that can get you into trouble—and it's gotten me into trouble and it's gotten a lot of people that I know into trouble—is your class peer-group pressure. Don't let the other people push you into going beyond your capability.

Many people are afraid to start an exercise program because they believe that exercise might aggravate an injury or illness, but with care, exercise can be part of almost anyone's life. Many studies confirm that regular, moderate exercise increases the body's ability to battle disease. In specific areas, such as cardiac rehabilitation, supervised exercise programs have been found to increase the effectiveness of cardiac output, increase endurance, and improve quality of life.

Cardiac effects of exercise include decreases in blood pressure for patients with hypertension, as well as increases in peripheral circulation, which reduces intermittent claudication (impeded blood flow to the legs). Exercise also improves blood flow to the brain and diminishes the risk of stroke in patients who have transient ischemic attacks (TIAs, or ministrokes). As we've noted, exercise tends to decrease the risk of developing diabetes in adults and improves glucose tolerance in patients who are already diabetics. Interestingly, exercise also has a positive effect on depression and emotional disorders.

With bone and joint diseases—osteoarthritis and rheumatoid arthritis—a well-planned exercise program improves joint function. It also tends to decrease pain and increase range of motion. With these diseases, you should emphasize low-impact exercises, such as gentle walking, biking, or swimming.

Be aggressive in the early treatment and prevention of injuries. Don't wait for severe pain or swelling before you treat a problem. Swimming is also a good exercise if you have had an injury; the weightless environment of

water provides some resistance but doesn't stress injuries that could be made worse by bearing weight.

Don't believe the expression "no pain, no gain." The body gives us coded signals that we need to listen to. You can push through an overall "burn" in your large muscles during exercise, but don't ignore localized, inflammatory pain, which can spread over time. Such pain is usually in a joint, near a tendon, or around a bursa, and it's a signal to stop.

During an illness, it's acceptable to push through a general feeling of tiredness but not a fever. The same is true if you have an upper respiratory infection or the flu. If you have a cold, substitute gentler exercises and be vigilant about your state of hydration.

Take care not to aggravate old injuries.

Overuse injuries are common, especially those that involve the ligaments, which have limited ability to stretch. A strain is a sudden tear, twist, or pull of the muscle, while a sprain is an injury to the ligament. **Tendonitis** is an inflammatory response of the tendon from overuse or direct injury. For these types of injuries, use the RICE protocol: rest, ice, compression, and elevation.

Splinting occurs when your muscles go into a spasm to keep you from moving the injured area. Shin splints are an overuse injury that commonly

occurs among runners. Injuries to the anterior cruciate ligament (ACL) seem to be increasing. The ACL keeps the knee—the upper part of the femur—from sliding backward and the tibia from sliding forward. Rotator cuff tears are also common because we tend not to strengthen the rotator muscles. Be cautious in resuming training after an injury because you may be surprised at how fast you've lost strength, endurance, or balance. ■

Important Term

tendonitis: Inflammation of a tendon.

Questions to Consider

1. Define and detail the differences between a strain and a sprain.

2. Describe the immediate treatment for acute bursitis or tendonitis.

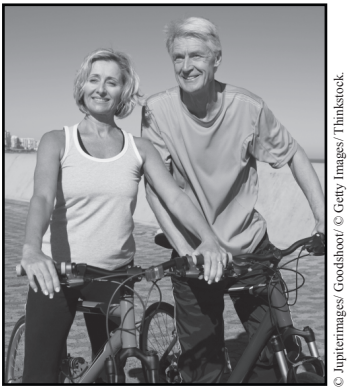
Joy in Movement—Sports and Exercise Options

Lecture 25

With the availability of Internet searches, I think you can look up almost any sport. You'll find some club for almost any of them, probably very near to you, that you never knew existed. Even in very small towns, there are huge varieties of sports that may be a little foreign to you.

In thinking about exercise and sports, we need to recapture the joy that we associated with play as children. In this lecture, we'll look at some sports that offer optimum benefits for our bodies and meet our Goldilocks criteria.

People choose to participate in sports for many reasons, from burning calories to finding new friends. Although virtually every physical activity generates health and well-being, it's important to choose forms that work for you. You want adequate intensity to benefit both cardio and strength, and you want adequate variety to maintain your interest.



Biking is one of the most popular aerobic physical activities.

One of the most popular physical activities with a good benefit-to-risk ratio is bicycling. Biking has the capability to offer both long aerobic workouts and high-intensity interval workouts. In some areas, you can find masters' classes in which groups of people ride together. There are some risks involved in biking, such as the possibility of traffic and terrain injuries, and you should always wear a helmet. Because biking doesn't involve much upper body work, you need to supplement it with other activities, such as swimming. Remember that swimming is a perfect exercise for the injured athlete, and it offers very high levels of aerobic and anaerobic activity.

Walking and hiking are great weight-bearing exercises. Both get you outside, with or without friends, and neither requires skill or special equipment. The hand weights that people sometimes carry when walking don't offer much benefit. For weight loss, aim to walk five days a week for about 45 to 60 minutes each day. Dancing is another wonderful social and aerobic activity. It offers benefits for muscle development, flexibility, and balance.

Racquet sports, such as tennis, racquetball, squash, and handball, impose some limitations in the areas of skill level and access. Furthermore, these sports are asymmetric, meaning that they develop one side of the body more than the other. Racquet sports can also be rough on many groups of joints, including those in the neck, back, and shoulders.

A relatively new activity is offered by indoor and outdoor climbing gyms. Scaling these artificial rock walls involves upper and lower body strength, core strength, balance, and flexibility. Other sports you may or may not have considered include fencing or kendo, skating, golf, skiing, snowshoeing, and Pilates. In short, there are hundreds of opportunities and options in choosing sports or exercise programs. I encourage you to find ways to move on a regular basis that offer variety in the kind of workout they provide and enjoyment for you. ■

Questions to Consider

1. Compare the pros and cons of swimming versus tennis as part of your exercise program.

2. Outline a complete cardiovascular training regimen and merge it with a compatible weight-training program that meets your Goldilocks criteria, including being enjoyable.

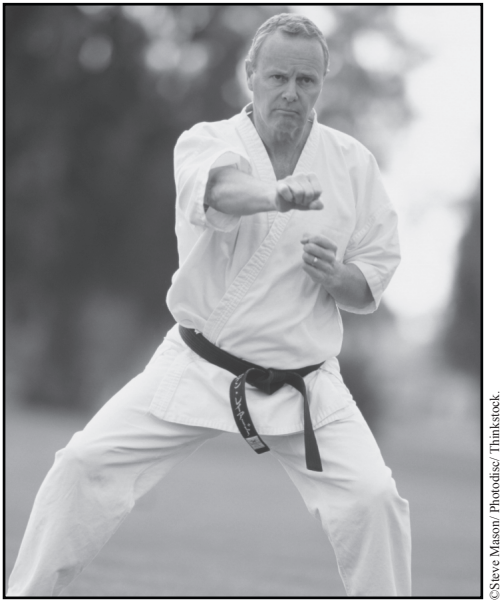
Martial Arts and Yoga

Lecture 26

In the martial arts specifically, we can benefit from getting a whole new sense of our bodies and develop a respect for an opponent who also happens to be our partner.

This lecture wraps up our section on exercise with a look at the martial arts and yoga. In both, there are numerous disciplines, teachers, and styles. Both also offer benefits for children and adults of all ages.

The **martial arts** have some common characteristics beyond the fact that they evolved as forms of fighting. There are traditions and clear rules of behavior inside the dojo (or training room). Almost all forms of martial arts also have a ranking system that's codified by experience, ability, and testing. Those are the colored belt ranks in karate, for example, that you're probably familiar with. Furthermore, they all involve basic training to improve strength, endurance, flexibility, and balance.



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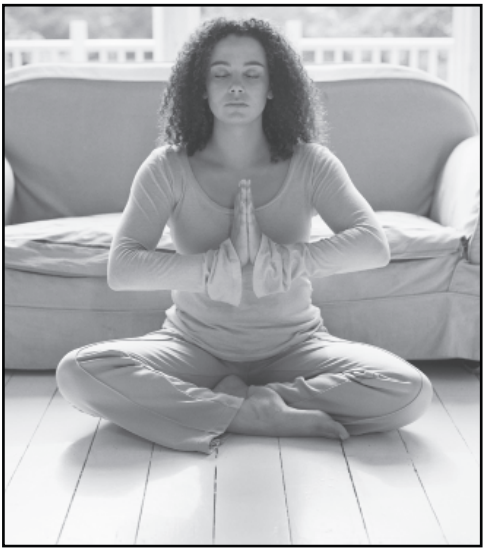
Martial arts practices offer a variety of benefits, both physical and mental.

The three most popular martial arts in this country are karate or karate-do, tae kwon do, and kung fu. They all are mainly composed of hand strikes, blocks, and kicks, although the kinds of kicks and strikes vary. Another group of martial arts includes judo and jujitsu. These emphasize grappling, grabbing, throws, and chokeholds. Aikido

focuses on maintaining your center—your locus of power—and using the opponent's center against him or her. It's a unique martial art in that it's completely defensive. The whole idea of aikido is blending; you blend with the force coming at you and move it in the direction it was already going. Aikido is especially good for women and children because it places greater emphasis on technique than strength. Kyu-do involves the use of a bow and arrow and is practiced as a form of meditation. Tai chi chuan, or tai chi, is another martial art that is safe for all ages and levels of fitness. There is almost no impact, moderate levels of exertion, and minimal stress on the joints. Tai chi has been shown to reduce anxiety, increase balance and coordination, improve sleep patterns, and decrease blood pressure.



One of the fastest-growing athletic pastimes in America is yoga.

Yoga is one of the fastest-growing athletic pastimes in America. Studies have shown that practicing yoga results in significant improvements in flexibility and strength within a few weeks. It is basically available to anybody at any level of fitness, strength, age, or illness. The physical practice of yoga involves a series of poses, the asanas.Each pose is designed to stretch certain muscles while relaxing the opposing muscle group. Some yoga styles are fast and flowing, while others are static. In all the styles, the emphasis is on strength training—both isometric in the static poses and isotonic in the flow, flexibility, circulation, balance, mindfulness, and breathing. The poses have the effect of regulating the blood flow to the muscles.

Both martial arts and yoga can be practiced at all ages and stages of life. Perfection in the moves or poses is not the goal. Visualize the correct form in your mind and aspire to it, but remember, it is the journey toward precision that counts. ■

Important Terms

martial arts: Arts of combat practiced as self-defense or as a sport or spiritual discipline.

yoga: A system of exercises, originating in India, designed to promote well-being of the body and mind.

Questions to Consider

1. In which form of martial arts would you prefer to participate? Why?

2. What are the basic properties of yoga that make it an important component in a complete exercise program?

Mental Health and Stress Reduction

Lecture 27

People choose to explore stress-reduction techniques mostly to intensify their ability to focus, to increase their creativity, to gain self-awareness and insight, and then to become relaxed and calm, especially in their minds. Quieting the mind allows us to become proficient at selectively focusing attention without becoming distracted or scattered.

With this lecture, we begin a series on lifestyle choices. We'll look at some of the concerns and options for men versus women and younger people versus older ones. We'll also see that mental and physical health are intricately interconnected.

Medical research suggests that our society is spiraling into increased stress-related illness. We live in what has been called the "age of distraction." It's almost impossible to escape the intrusion of noise, music, chatter, and lights. Multitasking has its limits, and it exacts a toll. Evidence increasingly points to the fact that mental and emotional stress have a direct effect on both mental and physical health.

The **prefrontal cortex** is the brain's planning center, the home of executive function. It sorts out conflicting thoughts, distinguishes between good and bad, and measures the consequences of our actions. Studies have shown that people who have established a **meditation** or relaxation practice have an increased ability to focus in the face of distraction. Relaxation techniques actually create a response that changes the patterns of genes associated with stress. As time goes on, we will probably find even more confirmation of the strength of the mind-body connection.

Although they are not a replacement for conventional medical treatment, stress-reduction techniques, such as meditation, yoga, prayer, and mindfulness, can help slow your heart and respiratory rates and lower blood pressure. These techniques can also decrease headaches, heart palpitations, back pain, and insomnia. Aspects of these techniques include focusing on

individual parts of the body and relaxing them one at a time, objectively observing the thoughts in your mind, or repeating a mantra.

Most relaxation techniques involve diverting or refocusing your attention from stressful issues to a calmer mental environment. **Mindfulness** techniques, developed by Dr. Jon Kabat-Zinn, emphasize being aware of and experiencing the present moment, much as children are able to focus completely on any given activity that they're engaged in. This form of stress reduction helps people cope with anxiety, illness, pain, and stress through mindfulness meditation. Dr. Kabat-Zinn defines mindfulness as the awareness that emerges through paying attention on purpose to whatever is unfolding in the experience from moment to moment. You observe your own feelings and thoughts, but you try to allow them to pass through without judging them.

It's my personal belief that if we can become more mindful in all ways—especially as we're exploring ways of eating, exercising, and the stories we tell ourselves about aging.

Mindfulness meditation and other techniques seek to reach a place where the mind is as quiet as it can be. Try to imagine finding the empty space between one thought that is departing from your mind and a new thought that is arising. The goal is to extend that space in time.

In using these techniques, regularity of practice is important. Try to find a solitary, comfortable place to meditate or practice stress reduction at about the same time every day. Focus your attention on the present moment. When your mind wanders and random thoughts intrude, don't judge them; let them pass away. You might focus on a simple object or on your breathing. Just as you can increase your physical fitness through practice, you can also improve your mindfulness. The reward will be that you can take control of the stress in your life and not allow it to control you. ■

Important Terms

meditation: A mental exercise designed to heighten concentration or spiritual awareness.

mindfulness: The awareness that arises through concentration and meditation.

prefrontal cortex: The brain's planning center, located between the temples in the forehead and behind the eyes.

Questions to Consider

1. Pick any kind of relaxation or stress-reduction technique and discuss its pros and cons and its benefits for physical health.

2. Describe the basics of mindfulness. Why is the practice of mindfulness so important in our lives today?

Brain Physiology, Alzheimer's, and Dementia

Lecture 28

The risk factors for vascular dementia are probably very obvious to you since the beginning of this course: atherosclerosis, diabetes, high cholesterol, high blood pressure, heart attacks in the past. We can prevent them much, much better than we can Alzheimer's disease.

In this lecture, we'll examine some of the functions of the brain and explore the possibilities for maintaining and improving brain function. The word "**neuroplasticity**" refers to our neurons—the cells that help us think—and plasticity, meaning the moldability of the brain, how it can manipulate itself and change its structure. There are about 100 billion nerve cells in the brain, and there are many techniques we can use to maintain, improve, and develop cognitive function as we age. These techniques are based on the concept of neuroplasticity, which we define as the brain's ability to increase the number and the complexity of connections among neurons throughout our lives.

New learning probably occurs all the time, and it occurs by modifying the strength of the connections among different neurons and by adding and deleting connections. **Axons** grow new nerve endings to connect with new neurons or with neurons to which they weren't previously connected. Through these connections, we learn new facts, develop new skills, and react to changes in the environment. The pathways that are used the most are maintained and strengthened.

Different kinds of mental activities may be needed to effect different kinds of cognitive improvement. Among the factors that are proven to promote increased cognitive function and slow cognitive decline is physical exercise. It heavily influences the brain blood flow, which may make the brain more efficient. Both physical exercise and mental challenges increase the secretion of nerve growth factors, which may promote neuron growth and maintenance.

It appears that learning anything new—mental or physical—is beneficial. For example, mental activities that require forward thinking and planning are important, such as chess, crossword puzzles, and math problems. These primarily benefit the frontal lobes. The acquisition of a new language brings in many different parts of the brain, which is probably good for developing neuroplasticity.

If you continually challenge your brain by a variety of new experiences, the brain will respond by maintaining and increasing its neuroplasticity, and it's the ability to function and learn throughout life that's based exactly on this.

The term "**dementia**" does not refer to a single specific disease. Dementia can stem from many causes and usually involves progressively chronic decline in cognitive function. The characteristics of the most common dementias are memory loss, impaired judgment or executive function, confusion, personality changes, and antisocial behavior.

Alzheimer's disease accounts for 60–80 percent of all dementias in the United States. One of the first and most consistent signs of Alzheimer's is memory loss of recent events; cognitive decline in other areas tends to appear much later. Other symptoms include impairment of language, behavior, and executive function. The physical brain pathology of Alzheimer's involves a loss of neurons and synaptic connections, gross brain atrophy, and the appearance of amyloid beta plaques (abnormal protein deposits). The Alzheimer's Association publishes 10 warning signs of the disease on its website. These include memory loss, problems with abstract thinking, disorientation, and difficulty with visual perception.

Vascular dementia, the second most common type, is the result of impaired blood flow to the brain. It may occur after a stroke or a series of small strokes that do not cause any major symptoms. Risk factors for vascular dementia include atherosclerosis, diabetes, high cholesterol, high blood pressure, and past heart attacks. ■

Important Terms

Alzheimer's disease: A progressive brain disease that is the most common cause of dementia; formerly called presenile dementia.

axon: A nerve fiber that carries electrical impulses.

dementia: Not a single specific disease but rather a condition that involves progressively chronic decline in cognitive function.

neuroplasticity: The brain's ability to reorganize and restructure itself by forming new neural connections.

Questions to Consider

1. Define neuroplasticity. Why is it critical to our understanding of brain function?

2. What would you look for in determining whether a relative or friend has Alzheimer's disease? Make specific suggestions. How does Alzheimer's disease differ from dementia?

Maintaining Your Mental Edge

Lecture 29

The bottom line is, the more a person is exposed in a positive way to family; to church or religious organizations; to clubs; to common-interest groups, like hobbies, sports, politics; and just a big circle of friends, the more they benefit in health of every kind, including mental health.

There are three main pillars for supporting age-related mental health and well-being: exercise, strong social interactions, and continuing mental stimulation.

As we've seen, the benefits of exercise affect all aspects of life and healthy longevity. A study at the University of Illinois at Urbana-Champaign found that adults between the ages of 60 and 75 who walked three times a week showed measurable improvement in cognitive function over those who performed a lower level of activity. Researchers concluded that six months of exercise will result in a 15- to 20-percent improvement in memory, decision-making ability, and attention. A literature review on the subject of exercise and cognitive function found that the greatest positive changes resulting from exercise were in the area of executive function. Exercise improves blood flow to the brain and stimulates brain chemicals, such as brain-derived neurotrophic factor, which is involved in the production of new neurons and the maintenance of existing ones.

Walking three times per week can improve brain function.

With regard to social interactions, studies have shown a straight-line improvement of cognitive skills for all ages with an increased number of interactions with friends, neighbors, and family members. In another study, socializing with friends and family was associated with decreased risk of cognitive decline and dementia as aging progressed. At the same time, social disengagement has been shown to be a major risk factor for cognitive impairment among the elderly.

Norman Cousins, whom I met many years ago, was a writer, a journalist, a peace advocate, and he wrote that "laughter is inner jogging." I love that expression.

Numerous studies have looked at the question of whether brain exercises can protect us from age-related cognitive decline. One study published in the *Journal of the American Medical Association* found that cognitive decline can be slowed or even reversed through mental exercises, but the improvement is generally limited to the specific skills that have been trained and is lost if the training is not continued. Some researchers believe that people who engage in intellectually stimulating activities tend to have the education and mind-set that promote better eating habits, social activities, and exercise. The benefits they accrue may stem from those factors rather than mental training. Given that mental function and performance can be improved in specific areas, such as memory, it may be worthwhile to train in those areas if you're starting to see some decline. Probably the best advice is to find activities that are both mentally stimulating and enjoyable, such as reading, traveling, or learning a new language.

Finally, some studies have looked at the benefits of laughter. Laughing has been shown to cause the blood vessels to dilate and increase blood flow to various organs, while stress causes restriction of blood flow. People who are laughing have been found to have similar levels of circulating chemicals in their blood as people who are working out. In the short term, laughter increases oxygen uptake and endorphins and activates a stress response similar to what occurs during exercise followed by relaxation. In the long term, it may actually upregulate the immune system and relieve pain. ■

Questions to Consider

1. What are three important ways to enhance cognitive growth and awareness as we age?

2. Discuss the effects of laughter or lack thereof on our general well-being. Discuss the effects of community and relationships or lack thereof on our general well-being.

Focus on Women's Health

Lecture 30

Because of the atypical signs and symptoms [of heart disease], fewer women are referred to cardiologists to get the workup and get the monitoring. Women and those who care about them need to be extra alert to these very, very subtle symptoms.

In this first of two lectures on women's health, we'll focus on a few of the greater concerns related to women's health; in the next lecture, we'll look at issues associated with menopause.

Of the top 10 most serious health issues for women, a number include smoking as an adjunct to other major risk factors. Heart disease tops the list, followed by cancer, stroke, chronic obstructive pulmonary disease (COPD), Alzheimer's disease, injuries, type 2 diabetes, flu, kidney disease, and sepsis.

One of the most important gender-specific issues for women is bone health. **Osteoporosis** is defined by reduced bone density and abnormal protein composition. The result is weakened bones with a propensity to fracture; hip fractures in particular present a serious threat for older patients. Risk factors for osteoporosis include aging in general, genetics, small stature, and Caucasian or Asian ethnicity. Some of the risk of osteoporosis can be mitigated by diet, including adequate intake of calcium and vitamin D; exercise; and avoidance of smoking. Diagnostic signs can be subtle, including back pain and loss of height. The preferred test to measure bone density is a DEXA scan.

Recall from an earlier lecture that 99 percent of our calcium stores are in our bones and teeth. A reduction of serum calcium—the 1 percent that's in the blood—leads to an increased output of parathyroid hormone, which in turn stimulates osteoclasts, a type of cell that breaks down bone and liberates calcium into the blood to maintain normal levels. Calcium supplements protect bone density by precluding the need for too much parathyroid hormone. Numerous drugs are available for treating osteoporosis, but these have a wide range of effects and side effects; it's important to

[Bone health] is where women have a very high degree of control. They have early opportunities for lifelong exercise and diet, and it really, really pays off.

have an experienced medical consultation to address osteoporosis.

Heart disease is another major health concern for women. As we've said, the leading killer of women over 50 is heart disease, and heart attacks are twice as deadly for women as for men. For a long time, the index of suspicion of heart disease was lowered for doctors when dealing with women as opposed to men. Furthermore, symptoms differ for men and women. Men generally present with substernal chest pain, while women often have no chest pain at all. They may get isolated jaw pain or symptoms that suggest indigestion. In women, the first sign of a heart attack may be congestive heart failure, in which the heart has such difficulty pumping out blood that fluids back up into the lungs. Mortality for a heart attack that shows up as congestive heart failure is much higher than without this condition. It's important to note, again, that women smokers have about four times the incidence of coronary artery disease as women who have never smoked.

A related health risk for women is depression. Twenty-five percent of women suffer depression at some point in their lives, and depressed women are twice as likely to suffer from coronary artery disease as nondepressed women. ■

Important Term

osteoporosis: A disorder characterized by weak and porous bones and a bone mineral density score of less than −2.5.

Questions to Consider

1. How can postmenopausal women preserve and strengthen their bones? What are some treatment options for osteoporosis?

2. How can postmenopausal women maintain a healthy heart? What are some treatment options for cardiovascular disease in women?

Focus on Menopause

Lecture 31

[Hormone replacement therapy] is one area of huge debate, and you're going to hear arguments on both sides. It's very important that you talk with your own health-care practitioner about the options that are available to you. We need to find out what works in your specific case.

Menopause is a normal part of aging, not a disease, but knowing this doesn't diminish the challenge of dealing with the symptoms that accompany even the most normal menopause transition.

Perimenopause, which can begin as early as the 30s, is the beginning of irregularities in the menstrual cycle. The earliest symptoms often relate to low progesterone and the progesterone-to-estrogen ratio. Symptoms during estrogen dominance in this ratio may include menstrual irregularity, hot flashes, mood swings, depression, vaginal dryness, loss of elasticity of the vaginal wall, episodic urinary incontinence, breast swelling and tenderness, and insomnia.

The medical community generally categorizes menopause into one of three types. Natural menopause usually begins between 45 and 55 years old; the transition to total cessation of the menstrual periods can take 5 to 10 years. Artificial menopause is usually secondary to removal of the ovaries for a medical reason or may occur after radiation to the pelvis or chemotherapy for cancer. The immediate cut-off of estrogens can lead to severe symptoms all at once. Premature menopause occurs unexpectedly in women who are about 30 to 40 years old. It may be a major problem associated with autoimmune diseases or a minor problem related to nutritional deficiencies. It may also appear in women athletes at the peak of conditioning. Menopausal symptoms in these women can be similar to those described for perimenopause but may be more frequent or intense.

The goal of hormone replacement therapy (HRT) is to lessen unpleasant symptoms rather than to reestablish normal estrogen levels. There are two variations of HRT: estrogen therapy (ET) and estrogen plus progesterone

therapy (EPT). ET alone carries a substantial risk of development of endometrial cancer in women after menopause. It is generally used with women who have had hysterectomies. With EPT, the progesterone offsets the risk of endometrial cancer, but after several years of use, EPT may increase the risk of breast cancer. EPT has also been found to increase the risk of cardiovascular disease, stroke, and venous thromboembolism (blood clots in the lung). HRT is now recommended only for menopausal symptoms that are moderate to severe; the lowest effective doses possible are prescribed for the shortest effective periods of time.

Bioidentical hormones are synthetic hormones manufactured using some plant-based sources. These are custom-made prescriptions that are usually chemically identical to the natural hormones in the body, and they're tailored to individual hormone requirements for each woman. They are advertised by their makers as being safer, and some are available as FDA-approved drugs, but generally, they have not been tested for purity, potency, efficacy, or safety.

For some women, the question of whether or not to use HRT may be a lifestyle issue. Such women should discuss the severity of their symptoms with their doctors. This is one area that can be affected by numerous variables, not only in symptoms but in health history and levels of tolerance for symptoms. You won't be surprised by the factors that I consider important in going through menopause: getting adequate sleep and exercise, reducing stress, and eating a healthy diet. ■

Important Terms

bioidentical hormones: Hormone replacements made from natural, plant-based sources.

menopause: A phase in the life of a woman that begins 8 to 12 months after her menstrual periods have ceased.

perimenopause: The beginning of irregularities in the menstrual cycle before the onset of menopause.

Questions to Consider

1. Define menopause and enumerate the most common symptoms that signal its onset.

2. Discuss the essential questions in the debate on the use of HRT for menopausal symptoms, with special attention to osteoporosis and hot flashes.

Focus on Men's Health

Lecture 32

I think you should test your PSA yearly after a certain age, somewhere in the 50s. You should get a biopsy if that test is positive, and then you make the decision as to the probability of the disease progressing or not.

In this lecture, we'll look at some health issues that are unique to men. We begin with the top health risks for men, which include heart disease, cancer, injuries, stroke, COPD, type 2 diabetes, influenza, suicide, kidney disease, and Alzheimer's.

Cancer, specifically prostate cancer, seems to be more worrisome to men than heart disease. The PSA test, which screens for **prostate-specific antigen**, is good for discovering early, asymptomatic prostate cancer, but it can also raise false alarms, which may lead to treatments that result in such complications as impotence or incontinence. With PSA testing, about 90 percent of prostate cancers are found very early. In fact, given that most prostate cancers are slow-growing and small, some in the medical community have suggested that PSA screening may find tumors too early. However, it's also true that prostate cancers can be aggressive. There is no nonbiopsy marker that can identify whether or not prostate cancer is aggressive or nonaggressive. Until we have that kind of testing, it's probably safer to get an early diagnosis through PSA screening than to forego the screening and risk finding out about cancer when it's too late.

Central obesity, or belly fat, is an important health issue for men.

Central obesity, or belly fat, is another important health issue for men. One study found that among four measurements—waist size, waist-to-hip ratio, waist-to-height ratio, and BMI

—heart disease risk was predicted by waist circumference alone. Central obesity is determined, to some extent, by genetics, but lifestyle and aging are also contributors. Risks associated with central obesity include type 2 diabetes, cancer, heart disease, stroke, and sleep apnea. The waist-to-hip ratio or the waist circumference are commonly used measurements to determine risk. A waist size of greater than 40 inches for men and 35 inches for women significantly increases health risks. Treatment generally comes down to lifestyle choices: a better diet and exercise.

Sit-ups and crunches and core abdominal exercises are terrific for general conditioning … [but] they have no effect on central obesity at all.

The question of whether **andropause**, or male menopause, actually exists is still under debate. Testosterone levels in men do not correlate with symptoms as well as hormone levels do in women. Men experience a gradual decline in testosterone levels over many years. The symptoms concurrent with this decline may include depression, fatigue, enlargement of the male breasts, height loss, thinning of the bones, infertility, reduced muscle bulk and strength, reduced sexual desire, and so on. Many of these symptoms are similar to age-related decline in men with normal testosterone levels. Testosterone replacement therapy may relieve some symptoms, but it carries some risks.

Erectile dysfunction (ED) affects a total of about 20 million men in the United States. Factors associated with ED include low testosterone levels, cigarette smoking, diabetes, coronary artery disease, high blood pressure, herniated lumbar discs, lipid disorders, and major bladder, prostate, or rectal surgery.

New studies suggest that vitamin D levels correlate with cognitive acuity in middle-aged and older men. There's still some controversy in this area, so don't megadose, but try to maintain at least normal levels of vitamin D.

Another interesting area is muscular strength and fat, or **adiposity**, as predictors of adult cancer death in men. Increased muscular strength has

been associated with a lower death rate from cancer in men, independent of central obesity. This may be another argument for keeping physically fit. ■

Important Terms

adiposity: Fat; state of being fat.

andropause: Male menopause.

erectile dysfunction: Chronic and consistent inability to reach and sustain an erection, along with the inability to engage in normal sexual activity.

PSA: Prostate-specific antigen, an antigen used in screening for early, asymptomatic prostate cancer.

Questions to Consider

1. What is the essence of the debate on PSA screening for men over 65, and where do you stand on the issue?

2. What are the dangers of belly fat? How can you determine if you have excess belly fat?

Focus on Children's and Adolescents' Health

Lecture 33

Some nutrition experts suggest the 80/20 rule: 80 percent of the time, focus on healthy, nutritional foods [and] good eating habits; 20 percent of the time, let [children] indulge and just have fun with it.

Just as you're never too old to start taking care of your health, you're never too young either. If parents exercise their influence early enough, they can counter many of the unhealthy cultural models we've seen throughout this course.

Among 13 European countries, the United States, and Israel, American children ranked highest in obesity. Studies also show that weight is the most critical area for determining health in children and sets the stage for well-being later in life. Perhaps most alarming is the fact that the current generation of American children may be the first to have a shorter lifespan than the previous generation because of poor nutrition and reduced physical activity. As we know, obesity later in life carries numerous risks, and we're now seeing some of these problems, such as type 2 diabetes and the beginnings of metabolic syndrome, in children.

Children's health experts suggest that parents can do a great deal to establish healthy eating habits early on. Keep nutritious snacks on hand and eliminate junk food. Ban television during dinner and don't force children to clean their plates. Involve children in meal planning, shopping, and preparation. Note, too, that studies have found a definite correlation between eating a good breakfast and performing well in school—and vice versa. Eliminate sodas from your home, which can leech calcium from bones, and substitute milk or fruit juice. If children get hungry between meals, give them foods that have high water and fiber content and little sugar. Serving meals that are balanced among carbohydrates, proteins, and fats keeps children feeling full over a longer period of time.

While focusing on healthy eating habits, don't go overboard and create unhealthy obsessions with food, which could lead to eating disorders.

Remember that children also get confused and anxious if we overstate the risks of pesticides in food or sugar and saturated fat. Parents, however, should be aware that chemicals and additives in food have a disproportionate impact on children because of their smaller body weight. It's an especially good idea to avoid any foods with artificial coloring.

We need to model all behaviors: eating healthy foods, not smoking, wearing seatbelts and helmets. Children need all of this from us as something they can follow.

Infants and children have immature immune systems, which means that the early introduction of allergenic foods can cause particular problems. Parents should ask their pediatricians what allergens to avoid and when they can introduce a wider range of foods.

Asthma is the no. 1 serious chronic illness in children. It's an inflammatory condition affecting the small bronchial airways where they meet the alveoli. It leads to an overreaction to certain inhaled substances, which causes the smooth muscle to contract. Although an asthma attack may make a person feel as if they are having trouble breathing in (and they are, to a small extent), what's really happening is that their airways are overfilling and the air can't get out. Attacks are often related to allergies, viral upper-respiratory infections, and airborne pollutants, such as secondhand smoke.

Finally, as parents, we should find ways to engage children in lifelong recreation. A good deal of research shows that young people of all ages benefit academically, socially, emotionally, and physically by participating in sports or exercise. ■

Important Term

asthma: An inflammation of the small bronchial tubes where they meet the tiny, sac-like alveoli; it leads to an inability to exhale.

Questions to Consider

1. Outline a program for healthy whole foods for children ages 3 to 16, with regard to requirements of specific nutrient groups.

2. Outline a similar program for healthy and fun physical activity for children ages 3 to 16.

Healthy Choices in Your Daily Life

Lecture 34

I believe, again, in the value of lifestyle changes. This kind of treatment—getting more sun, preparing yourself for sleep—is much better than supplements. The balance of nutrition, exercise, [and] mental health principles still makes the most sense.

We begin this lecture on daily choices for optimum health with the topic of sleep. Studies confirm that both physical and mental health can be improved by taking 30-minute naps late in the afternoon. If you can't nap, it's still helpful to rest quietly with your eyes closed; you'll achieve something similar to the meditation and stress-reduction benefits we spoke about earlier. Your nighttime sleep goal should be about 7 to 8 hours.

Sleep deprivation is a major problem in the United States. It's prevalent in all age categories, from the late teens to the very elderly. Studies have shown that both physical and mental performance suffer greatly, even with minor sleep losses. Sleep deprivation is also linked to high blood pressure, depression, heart disease, and erratic blood glucose levels. Some people suffer from obstructive sleep apnea, in which the airway closes down while an individual is asleep, causing the sleeper to wake, gasping for breath. The chronic sleep deprivation associated with sleep apnea can have serious health consequences.

Sleep deprivation affects most age groups in the United States.

Sleep medications have been developed from **melatonin**, a sleep-regulating hormone, and

tryptophan, the precursor to melatonin. Over-the-counter drugs may be effective for mild insomnia but should be reserved for short-term use. If you have difficulty sleeping, experts suggest avoiding other activities in bed, such as reading; buying a good mattress; keeping the temperature cool; and avoiding late-night meals, caffeine, and alcohol, which may interfere with the quality of sleep. Increasing the time you spend in natural sunlight may also help in pushing the sleep hormones toward a favorable balance at nightfall.

Some in the scientific community are now questioning the idea that drinking alcohol in moderation is beneficial. Observational studies show a connection between moderate use of alcohol and lower death risk, but no prospective, randomized, double-blind studies have been performed. Rather than gaining any benefit from the alcohol itself, it may be true that healthy people simply choose to drink moderately. Note, too, that alcohol consumption is associated with increased risk of cancer, accidents, and liver disease and causes shrinkage of the brain, even in moderate amounts.

We should, however, drink lots of water. You may not need eight 8-ounce glasses of water a day, but it's better to have too much water than too little. The best gauge for whether or not you're drinking enough water is urinary output and color. Dehydration poses special risks for the elderly, who can easily go into shock from the associated drop in blood pressure.

Keeping household air free of dust, allergens, and toxins, particularly fumes from building materials, is a challenge. In medicine, we say that the solution to pollution is dilution. Find ways to keep the air in your home circulating and refreshed.

Finally, if you are a caregiver of someone who has special needs, it's critical that you also take care of yourself. Look to resources in the community, such as home health-care providers or senior centers, that may be able to give you some time off. Keep up with your own social interactions and maintain a routine of good diet and exercise. ■

Important Term

melatonin: A sleep-regulating hormone also involved in modulating the circadian rhythms.

Questions to Consider

1. Discuss the role of getting adequate sleep in maintaining optimum health. What are ways we can we deal with inadequate sleep patterns?

2. Other than getting sufficient sleep, what other lifestyle choices can we make to better our lives?

Becoming an Educated Patient

Lecture 35

Try to establish … an e-mail relationship with your doctor if he'll let you. You can get answers to questions and prescriptions and lab reports. It saves you both a lot of time, and it's much more convenient for everyone.

An educated patient makes for the best relationships with health-care practitioners, and it's important to establish such relationships before you need them. In looking for a doctor, one trick is to find out who doctors go to themselves or who they refer their families and friends to. With specialists, you should also check for board certification or board eligibility. If you're advised to undergo a procedure, ask how many similar procedures the surgeon or specialist performs per year. The answer should be in the range of 50 to 100.

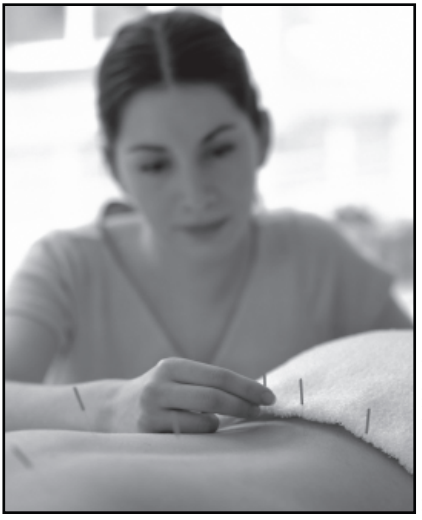
You may sometimes hear the word "noncompliant" in reference to a patient who doesn't follow a doctor's instructions. I believe that as doctors, we need to make sure that the patient understands the pros and cons of a treatment, then participates equally in the decision of whether or not to go forward.

No matter what your age, if possible, have a friend or a family member go with you to the doctor. Get written instructions and follow them carefully. Be honest with your doctor, who may know better than you do what's relevant to your treatment. Don't be embarrassed to discuss your alcohol, tobacco, and drug use and your sexual and eating habits.

When you go to an appointment, bring a written list of your questions, along with a diary of recurring symptoms. You should also have a complete list of your medications and supplements and the details of your family medical history. If you're in doubt about medical advice you've received, get an independent second or even third opinion.

I believe strongly in something called patient-centered care, which establishes a relationship of mutual respect between patient and doctor. As I've said,

I also believe in being completely truthful with patients. The facts of a diagnosis are usually less frightening than the patient's fantasies.



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Alternative medicines such as acupuncture benefit many patients.

Conventional medicine is what most of us experience when we go to the doctor. Alternative medicine is a term that describes treatments that are used in place of conventional medicine. Complementary medicine describes a situation in which an alternative is used together with conventional medicine. Integrative (or integrated) medicine refers to a balance between conventional and proven alternative options. It focuses on prevention and the real causes of disease based on lifestyle modification.

Some systems of **alternative medicine** you might have heard about include naturopathic, homeopathic, Chinese, and Ayurvedic medicine. Other alternative treatments are biologically based, such as herbs; body-based, such as chiropractics or massage; or mind-based, including mindfulness and stress reduction. Evidence-based research has been done on some of these alternative modalities, while the safety and efficacy of others are still under review. **Acupuncture** is one alternative that has been studied extensively. There is no scientific basis for the theory behind acupuncture, but it seems to benefit many patients.

Be aware that there is a good deal of medical misinformation on the Internet. When conducting online research, look for the dates of the studies referenced, then go to the original source of the information. Always look for peer-reviewed, randomized, prospective, double-blind studies. Stay away from information on commercial sites and be skeptical of pseudo-medical jargon. ■

Important Terms

acupuncture: A Chinese science invented more than 1,000 years ago involving the insertion of very thin, sharp needles through the skin and into the underlying tissue to varying depths; intended to relieve pain, nausea, and so forth.

alternative medicine: Practices used in place of standard conventional treatments.

Questions to Consider

1. Why is it crucial to give your health-care professional truthful and complete answers to questions she or he might pose?

2. Make up three questions you might want to ask your surgeon when discussing the possibility of having your gall bladder removed.

Here's to Your Healthy Life!

Lecture 36

Gardening together can be social, full of family and friends and neighbors. It can be very mindful. It can be meditative and contemplative. I often find myself using it as mindfulness work.

This lecture series has covered a number of the overarching topics related to aging and ways to maintain good health and avoid risk as we age. We have also explored the physiology of nutrition and exercise; looked at mental health; examined health issues unique to women, men, and children; and identified some generally healthy choices that can benefit us all. We've emphasized some key themes that will serve us no matter how the science of health changes, especially the Goldilocks criteria and the idea that it's not nice to fool Mother Nature. Remember, too, that one-degree change in course that we talked about in the first lecture. Start with small, positive changes that will accumulate over time. Most important, make choices that will bring joy to the journey of life.

In my opinion and that of many others in the medical community, the combination of whole foods and enjoyable exercise is the winning ticket for longevity. As we've discussed throughout this course, choose whole, healthy foods, and think of your diet as a way of living, not just a way to lose weight. Check out your local farmers' market, community-supported agriculture group, or food co-op, or start your own garden.

Exercise or movement should also be part of our lives, but it doesn't have to be high-level exercise. Dr. Paul Dudley White, founder of the American Heart Association, pioneered what is now called preventive cardiology, a combination of exercise, diet, and weight control to prevent heart disease. Dr. White did a great deal to push Americans toward exercise of every kind. In your own exercise or recreation, try to sample the full buffet of sports and find the fun in physical fitness.

The people of the blue-zone cultures we talked about all have strong community and family ties and make time in their lives for relaxation and

inner focus. Keep in mind that we all need regular mental, physical, and emotional breaks.

The Harvard Study of Adult Development is the longest-running longitudinal study of human longevity ever conducted. It began in 1937 with 268 male Harvard undergraduates and was prompted by the idea that medical research often concentrates only on people who are sick. In this study, healthy aging seemed to be predicted by several major factors, including the use of "mature adaptations" in dealing with problems (something akin to mindfulness), level of education, exercise, avoidance of tobacco and alcohol use, and stable relationships. Half the men who scored high in five or six of these factors at age 50 were classified as happy and well at age 80. Between the ages of 50 and 75, altruism and a sense of humor dominated as positive factors in the lives of these men, while depression correlated with poor physical health in later life. Marriage and faith also correlated with high levels of happiness. In short, the Harvard study confirmed all the parameters we've looked at for optimum health and well-being.

It's never too late in life to start finding the joy in movement. Go slowly; it's for life.

As you start building your own unique and solid foundation for longevity, always remember that the journey is far more important than the destination. Find ways to integrate health and joyfulness into your routines every day. ■

Questions to Consider

1. Summarize the implications of eating whole, healthy foods, getting plenty of exercise, and incorporating other healthy habits into your lifestyle for ensuring well-being as you age.

2. After the first lecture, you were asked to list five common physical and/or mental changes that you believe generally occur with aging and whether they are inevitable or can be modified. How has this course changed your mind about those changes? Likewise, how has the course encouraged you to change specific aspects of your current lifestyle to improve your overall health and well-being?

Supplemental Material

Table 1. Body mass index

Category	BMI
Underweight	<18.5
Normal	18.5–24.9
Overweight	25–26.9
Obese	27–29.9
Moderately obese	30–34.9
Severely obese	35–39.9
Morbidly obese	>40

Note: To calculate your body mass index (BMI), multiply your weight in pounds by 703, then divide by your height in inches squared. For example, if you are 5 feet 6 inches tall and weigh 150 pounds, your BMI is calculated as follows:

$$150 \times 703 = 105{,}450$$
$$66^2 = 4{,}356$$
$$105{,}450 \div 4{,}356 = 24.2$$

Thus your weight is considered normal and healthy for your height.

Table 2. Major vitamins at a glance

Vitamin	Function	Sources and stability
Retinol (vitamin A and provitamin A)	Produces vision pigment; promotes resistance to infection and growth of healthy epithelial cells.	Fish; liver; dark orange, yellow, and red fruits and vegetables; dark green leafy fruits and vegetables. Heat stable. Destroyed by exposure to light and the type of packaging material.
Ascorbic acid/ L-ascorbic acid (vitamin C)	Maintains iron in its reduced state to preserve activity of at the catalytic site.	Fruits and vegetables, especially oranges, grapefruit, papaya, and strawberries. Destroyed by light, heat, air, iron, or copper.
Cholecalciferol (vitamin D_3)/ ergocalciferol (vitamin D_2)	Facilitates calcium absorption from the intestine and maintenance of phosphorus levels in blood. As antioxidants, prevent oxidation of unsaturated fatty acids and maintain the integrity of cell membranes.	Fatty fish, egg, liver, and fish liver oils. Available mostly in artificially fortified products, such as milk, yogurt, breakfast cereals, and breads. Very stable, but pure cholecalciferol samples are destroyed by high temperatures and humidity. Most stable form is obtained by encapsulating vitamin D_3 within a protective matrix.
Tocopherol (vitamin E)	Maintains the integrity of cell membranes.	Vegetable oils, leafy green vegetables, and whole grains (wheat germ). Destroyed by heat, light, and oxygen.
Quinones (vitamins K_1 and K_2)	Formation of several blood clotting factors in the liver. Synthesized by bacteria in the large intestine.	Green leafy vegetables and some fruits, dairy products, meat, and eggs. Moderately stable to heat and reducing agents. Destroyed by acid, alkali, light, and oxidizing agents. Best derived from food sources only.

Dietary reference intake	Disorders related to deficiency	Disorders related to toxicity
Men: 900 mcg Women: 700 mcg Upper adult limit: 2,000 mcg	Alcoholism (by precipitating zinc deficiency), celiac disease, fat malabsorption disorders, and respiratory disease.	Cheilitis (dry lips); nasal, eye, and skin mucosa dryness; hair loss, nail fragility, bone pain, gingivitis, hepatomegaly, and ascites.
Men: 90 mg Women: 75 mg Upper adult limit: 1,925 mcg (77,000 IU)	Scurvy (weakened connective tissue, lesions/ impaired wound healing, poorly formed collagen).	Nausea and diarrhea (rare).
Adults, 51–70 yr: 10 mcg (400 IU) Adults >70 yr: 15 mcg Upper adult limit: 2,000 IU	Rickets, depression, abnormal functioning and premature aging.	Excess or deficiency can cause abnormal functioning and premature aging.
Adults: 15 mg Upper adult limit: 1,000 mg	Sterility, cystic fibrosis.	No known toxicity.
Men: 120 mcg Women: 90 mcg Upper adult limit: N/A	Bleeding disorders, increased risk of spontaneous hemorrhage.	Thrombogenesis, hemolysis, and increased risk of jaundice (rare).

Table 3. B vitamin information at a glance

B vitamin	Function	Sources and stability
Thiamin (B1)	Breaks down carbohydrate..	Fortified cereals, pork, and navy beans. Destroyed by heat and baking soda.
Riboflavin (B2)	Supports energy metabolism.	Liver, fortified cereals, milk, and yogurt. Destroyed by UV light.
Niacin (B3)	Supports energy metabolism.	Meat, poultry, nuts, peanuts, and cereals.
Pantothenic acid (B5)	Synthesizes coenzymes important for fatty acid energy metabolism.	Beef, poultry, potatoes, and vegetables.
Pyridoxine (B6)	Amino acid metabolism.	Liver, fish, poultry, fruits, and whole grains. Destroyed by heat.
Biotin (B7)	Fatty acid synthesis and metabolism, gluconeogenesis, and amino acid metabolism.	Liver, nuts, and eggs.
Folate (B9)	Metabolism of amino acids and synthesis of DNA; cell division and development of neural tube in fetuses.	Fortified cereal, spinach, broccoli, black and pinto beans, orange juice, and potatoes. Extremely vulnerable to heat.
Cyanocobalamin (B12)	Folate absorption; synthesis of myelin.	Liver, meat, eggs, and milk.

Dietary reference intake	Disorders related to deficiency	Disorders related to toxicity
Male, 19–70 yr: 1.2 mg Female, 19–70 yr: 1.1 mg	Beriberi; “pins and needles” sensation.	No known toxicity.
Male, 19–70 yr: 1.3 mg Female, 19–70 yr: 1.1 mg	Mouth sores and inflammation.	No known toxicity.
Male, 19–70 yr: 16 mg Female, 19–70 yr: 14 mg Upper limit, adult: 35 mg	Pellegra.	Flushing and redness.
5 mg	Rare.	No known toxicity.
Adult, 19–50 yr: 1.3 mg Male, 50–70 yr: 1.7 mg Female, 50–70 yr: 1.5 mg Upper limit, adult: 100 mg	Microcytic hypochromic anemia.	Weakness; numbness.
Adult, 19–50 yr: 30 mg	Rare.	No known toxicity.
Adult: 400 mcg Upper limit, adult: 1000 mcg	Neural tube defects in fetuses; macrocytic anemia.	No known toxicity but can mask a B12 deficiency.
Adult: 2.4 mcg	Pernicious and macrocytic anemias.	No known toxicity.

Source: Data from Northwestern University, “Nutrition Fact Sheets.”
Note: yr = year; mg = milligram; mcg = microgram.

Glossary

abdominoplasty: Surgical removal of excess skin and fat to flatten out the abdomen.

absolute risk: The actual numerical chance or probability discovered during a study, presented without context, using numbers or percentages. For example, if a study of two drug treatments shows that a risk of death from using one drug is 1 out of 7,000 and the risk of death from using the second drug is 2 out of 7,000, then the difference in absolute risk is very small (a rise of only 1 death in 7,000 participants). In contrast, the **relative risk** for using the second drug (an increase from 1 to 2) shows a 100 percent increase.

acetylcholine: A neurotransmitter that functions in the human nervous system to activate muscles.

acidosis: Excessive acid in bodily fluids.

acne mechanica: Acne often triggered by heat or excess scrubbing or rubbing.

acne vulgaris: Common acne caused by inflammation of pores or hair follicles.

acupuncture: A Chinese science invented more than 1,000 years ago involving the insertion of very thin, sharp needles through the skin and into the underlying tissue to varying depths; intended to relieve pain, nausea, and so forth. The aim is to restore a harmonious balance between the yin and the yang energies of the life forces, or Chi.

acute pain: Pain that resolves itself quickly. *See also* **chronic pain**.

ADP: Adenosine diphosphate, the molecule that results from the removal of one phosphate from an ATP molecule by enzymes, releasing usable metabolic energy.

ATP: Adenosine triphosphate, the molecule that transports energy within the cells of the body.

adiposity: Fat; state of being fat.

adjuvants: Additives that allow needle-free administration of vaccines.

adult-onset diabetes: *See* **type 2 diabetes**.

aerobic: The stage in the metabolic generation of energy that uses oxygen to burn glucose.

aerobic capacity: The maximal ability of an individual's body to consume oxygen during physical activity.

aikido: Also known as "the way of the central spirit," a Japanese martial art that emphasizes nonresistance and the use of an opponent's momentum against him or her.

allergen: A substance that can cause an allergic reaction, such as a food or medicine.

allicin: A potent antioxidant.

alpha-linoleic acid: A type of omega-3 fatty acid.

alternative medicine: Practices used in place of standard conventional treatments.

Alzheimer's disease: A progressive brain disease that is the most common cause of dementia; formerly called presenile dementia.

amyloid beta plaques: Abnormal protein deposits found in the brains of Alzheimer's disease sufferers.

anabolic reactions: Reactions that consume energy and are used to resynthesize compounds.

anaerobic exercise: Fast-burst, high-intensity exercise used to build strength and muscle mass.

anaphylactic shock: A life-threatening condition with sudden onset; often brought on by severe allergic reaction.

andropause: Male menopause.

angina: Chest pain of cardiac origin caused by lack of blood flow.

angiogenesis: The in-growth of new blood vessels.

angioplasty: A medical procedure performed to widen existing coronary arteries.

anthocyanins: Powerful antioxidants.

antigravity training: Forms of exercise, such as swimming, that minimize the effects of the body's weight during a workout.

antioxidants: Substances that may protect cells by neutralizing the free radicals that damage cells and tissue.

apoptosis: Programmed cell death.

apple-shaped body: A body shape with more weight around the waist than around the hips.

arachidonic acid: A type of omega-6 fatty acid.

arrhythmias: Rhythm disturbances in the heart.

artificial menopause: Menopause brought on secondarily by removal of the ovaries for a medical reason; artificial menopause can also occur after radiation to the pelvis or chemotherapy for cancer and with some medications. This condition is usually abrupt and can lead to severe symptoms that may be treated with hormone replacement therapy.

asanas: Positions in yoga.

asthma: An inflammation of the small bronchial tubes at the very end of the airways into the tiny, sac-like alveoli; it leads to an inability to breathe air out.

atherosclerosis: Hardening of the arteries.

axon: A nerve fiber that carries electrical impulses.

axonal or dendritic pruning: Elimination of excess axonal branches and synaptic contacts often formed during early development.

ballistic stretching: A form of stretching that involves a bouncing motion; not beneficial for the body.

bariatric surgery: Weight-loss surgery performed on the obese that modifies the gastrointestinal tract.

basal metabolic rate: The speed at which the body burns energy while at rest.

bioavailability: The amount of a nutrient that the body can absorb and utilize.

biodegradable polymer technologies: A way to deliver booster doses of a vaccine long after an initial single injection.

bioidentical hormones: Hormone replacements made from natural, plant-based sources.

bisphosphonates: A family of drugs used to treat osteoporosis.

blue-zone communities: Areas of the world where the inhabitants tend to live longer and healthier lives.

board certification: Official recognition conferred on physicians who have met high standards of training and performance and have successfully passed rigid examinations in their areas of specialty.

board eligibility: Recognition conferred on physicians who have completed all requirements for certification except the examinations.

body mass index (BMI): The standard method of determining an individual's healthy weight range by height-to-weight ratio. To calculate, multiply your weight in pounds by 703, and divide by your height in inches squared. A BMI of less than 24.9 is considered normal weight; between 25 and 29.9 is overweight; and greater than 30 is obese. You can find a useful BMI calculator at http://www.cdc.gov.

bokken: Wooden training sword used in aikido.

brain-derived neurotrophic factor: A molecule involved in maintaining normal cognitive and emotional functioning.

BRCA: Tumor-suppressor gene mutations strongly linked to both breast and ovarian cancers.

bursa: Fluid-filled sacs that provide smooth, frictionless movement at or near a joint.

bursitis: Inflammation of the bursa.

calcification: Deposits of calcium salts in tissue, causing hardening.

calcitonin: A hormone produced by the thyroid gland that interferes with the osteoclasts and slows bone loss.

calisthenics: A system of body exercises; the term is a combination of words meaning "beauty" and "strength."

capillary network: Tiny vessels where the exchange of glucose, oxygen, and waste takes place.

carcinogen: Cancer-causing agent.

cardiorespiratory capacity: Ability of the heart and respiratory system to work together to generate energy.

CAT scan: Computerized axial tomography, a procedure used to identify disease or other abnormalities; a CAT scan machine uses computer technology to generate a three-dimensional image, or cross-section, of the body.

catabolic reactions: Metabolic reactions that break down molecules.

cellular distress: Stress on individual cells of the musculoskeletal system, arising from lack of oxygen, lack of glucose, or actual physical stress.

central obesity: A condition characterized by belly fat.

cholinesterase: An enzyme found primarily at nerve endings that helps transform acetylcholine into acetic acid and choline.

cholinesterase inhibitors: Drugs used to treat the symptoms of Alzheimer's disease.

chondroitin sulfate: A substance that prevents the breakdown of joint cartilage.

chronic obstructive pulmonary disease (COPD): A condition that includes the lung diseases chronic bronchitis and emphysema.

chronic pain: Pain that lasts a long time. *See also* **acute pain**.

circadian rhythm: The body's approximately 24-hour cycle of waking and sleeping; closely linked to the basic metabolism of cells and organs.

cirrhosis: Liver scarring, often the result of alcoholism.

clinical impression: A diagnosis professionals provide after a patient assessment.

cognition: Mental processes that include attention or focus; the acquisition of new information; memory; language and speech; and the translation of intention into movement through motor skills.

collagen protein: Proteins found in connective tissue and bones.

colonoscopy: A procedure using a flexible instrument to see inside the colon and rectum.

complementary medicine: The system of combining alternative treatments with conventional medicine.

complete protein: A protein source that has all the essential amino acids.

complex polysaccharide: A string of chemical sugars combined to form a starch.

concentric contraction: Muscle contraction in which the muscles shorten to produce motion against a force. This is a muscle's preferred way to work. *See also* **eccentric contraction**.

confounder: An extraneous variable in a medical study that might affect and threaten the validity of inferences and results of the study.

congestive heart failure: A form of cardiovascular disease in which structural or functional problems impair the heart's ability to provide adequate blood flow to the rest of the body.

conventional medicine: The system of medicine most often practiced by physicians and other health-care professionals, such as therapists, psychologists, pharmacists, and nurses.

conversational jog: Level of exertion at which an individual can carry on a conversation with a partner while running.

coronary artery disease: A condition in which plaque builds up inside the arteries of the heart.

cosmetic rhinoplasty: Surgical reshaping of the nose for cosmetic reasons.

cosmetic surgery: Surgical procedures performed to improve appearance.

cross-training: Engaging in a number of exercises for well-rounded aerobic and muscular development.

delayed-onset muscle soreness: A feeling of muscle pain a day or two after exercising.

dementia: Not a single specific disease but rather a condition that involves a progressive, chronic decline in cognitive function.

destructive exogenous free radicals: Free radicals that arise from outside sources, such as ultraviolet and other forms radiation, toxins, and pollutants.

DEXA scan: Dual-energy X-ray absorptiometry, a procedure that measures bone mineral density.

DASH diet: Dietary Approaches to Stop Hypertension, a way of eating designed to lower blood pressure developed by the American Heart Association.

diphenhydramine: An antihistamine; drowsiness may be a side effect.

disaccharide: A combination of two monosaccharides.

disuse atrophy: A degeneration of muscle mass due to inactivity.

docosahexaenoic acid: A type of omega-3 fatty acid.

dojo: Training arena for martial arts.

dynamic stretching: Stretching that uses speed, momentum, and active effort to exercise the muscle. *See also* **static stretching**.

eccentric contraction: An elongation of the muscle in response to a force—a "negative" motion. *See also* **concentric contraction**.

eicosapentaenoic acid (EPA): A type of omega-3 fatty acid.

elastic resistance bands: An exercise tool used in resistance training; the more the band is stretched, the greater the resistance.

eluting stent: A stent that releases anticlotting chemicals over time.

emotionally labile: Changeable, unpredictable.

endemic: An abnormality exhibiting high levels in an otherwise apparently healthy population.

endometrium: The lining of the uterus.

endorphins: Chemicals released by the brain that are similar in structure to the morphine or opium group of drugs.

enteric-coated aspirin: Aspirin treated with a special coating to pass through the stomach unaltered and to dissolve in the intestines, thus preventing stomach upsets.

epigallocatechin gallate: A highly powerful antioxidant found in tea.

erectile dysfunction: Chronic and consistent inability to reach and sustain an erection, along with the inability to engage in normal sexual activity.

estrogen: A female hormone produced by the body (especially in the ovaries) and necessary for the normal sexual development of the female.

estrogen decline: The decreased ovarian production and excretion of estrogen.

estrogen receptors: Molecules on the surface of certain cells in the body to which estrogen will bind.

executive function: A higher-level cognitive ability that guides complex behaviors, such as planning, decision making, and self-monitoring.

fascia: A layer of tissue that holds muscles together and provides a place for blood vessels, nerves, and interstitial or intercellular fluid to move.

fiber: The indigestible part of plant food (roughage) that creates bulk in the digestive system. It absorbs water, promotes defecation, and may aid in eliminating toxic wastes.

first-class lever: A lever with its fulcrum (support) between the point of resistance and the point of effort. An example in the human body is the motion used when the head is raised off the chest.

firsthand smoke: Smoke inhaled directly during the act of smoking a cigarette.

food allergies: Unexpected, unintended reactions to various foods or substances in foods.

forkhead box family: The *FOX* gene family, which produces transcription factors that play an important role in development and longevity.

FOXO: A subgroup of the *FOX* gene family that regulates metabolism and, possibly, lifespan.

FOXO3A: A gene variation that appears to have a powerful positive effect on life expectancy.

free graft: A graft that involves separating a very thin layer of skin from one part of the body and attaching it to another site.

free-motion machines: Exercise machines that help activate a number of muscles, rather than focusing on a narrow group.

free radicals: Very unstable and highly reactive atoms or groups of atoms with an odd (unpaired) number of electrons, which increases their tendency to bond with other molecules. Free radicals can damage cells and are believed to be responsible for aging, tissue damage, and possibly some diseases.

free weights: Equipment used in strength training to target specific muscle groups.

gamma wave: A brain wave pattern with a high frequency, thought to signify a high state of focus and concentration.

giant sets: A fitness routine in which a number of exercises are performed for the same muscle group with almost no rest between sets.

glucosamine: A substance that helps in the formation and repair of cartilage and other body tissues.

glucose: A simple sugar (monosaccharide) that is an important carbohydrate and the major energy source for the body.

glucose tolerance test: A test that measures the body's ability to use sugar (glucose), our main source of energy.

glycemic index: A numerical index that ranks carbohydrates (on a scale of 0 to 100) based on the rate of conversion of the carbohydrate to glucose inside the body and its entrance into the bloodstream.

glycogen: Glucose that can be stored in the liver and muscles for future use.

grading: A measure of the biologic aggressiveness of a cancer.

gross brain atrophy: Loss of neurons and their connections in the brain.

gynecomastia: Enlargement of the male breasts.

hakama: Long dress worn by kendo practitioners.

half-moon pose: A pose in yoga that strengthens the ankles and thighs and improves balance.

herbal supplements: Supplements derived from plants.

herniated lumbar discs: Ruptured or slipped discs in the spine.

HDL: High-density lipoprotein, or "good cholesterol," which removes excess cholesterol from the arteries and carries it to the liver for destruction. High levels of HDL are associated with decreased risk of heart disease.

HEPA filters: High-efficiency particulate air filters that can trap large numbers of small airborne particles and thus purify the air.

high-fructose corn syrup: A common sweetener composed of fructose and glucose.

high-intensity interval training: A form of training that involves short intervals of maximum-intensity exercise.

histamine: A substance released by the body during an allergic reaction.

homeopathy: A therapeutic method designed to treat disease by giving a patient minute doses of highly diluted, symptom-causing substances in an effort to stimulate the body's ability to heal itself. Little evidence exists to support the effectiveness of homeopathic treatment.

hormone manipulation: Changing the levels of estrogen vis à vis androgenic hormones.

hot flashes: Episodic flushing and sweating.

hydrophobic molecules: Molecules that do not dissolve in water.

hypertension: High blood pressure.

hypertrophy: An increase in mass or girth. For example, exercise can cause hypertrophy in muscle tissue.

hypervitaminosis: Excess vitamin intake.

inflammation: A bodily response to disease or tissue damage, resulting in swelling, redness, and pain.

insulin: An anabolic hormone in the pancreas responsible for moving glucose and other essential nutrients into cells.

insulin resistance: A condition in which normal levels of insulin are no longer sufficient to obtain the glucose-lowering effects of insulin in major tissues, such as fat, muscle, and liver.

insulin sensitivity: A condition in which very small amounts of insulin are required to keep the body's blood sugar levels in the normal range.

integrative (or **integrated**) **medicine**: A combination of conventional practices and proven alternative treatment options.

intercurrent disease: A new disease that intervenes during the course of another disease not related to the primary disease.

intermittent claudication: Pain caused by impeded blood flow to the legs, usually the calves.

intra-abdominal fat: Fat accumulating in and around the abdominal cavity and organs.

isometric contraction: A muscle exercise in which the muscle is not lengthened.

isotonic contraction: A muscle exercise in which the tension on the muscle stays the same despite a change in muscle length.

judo: From Japanese for "the gentle way," a sport derived from jujitsu that uses principles of balance and leverage.

jujitsu: A Japanese art of fighting without weapons, using holds, throws, and blows.

karate: The Japanese art of self-defense using kicks and punches.

kata: A technique of practicing the positions and movements of martial arts.

kendo: From the Japanese for "the way of the sword," the sport of fencing using a wooden or bamboo sword.

ketone bodies: Soluble compounds produced when fatty acids are broken down for energy in the body.

Krebs cycle: The energy-producing cycle in the body.

kung fu: A Chinese martial art that emphasizes not only fighting skills but also balance and concentration.

kyudo: Literally, "the way of the bow," the Japanese sport of archery, practiced for both physical and spiritual development.

laparoscopic surgery: Minimally invasive surgery using only a few small cuts in the body and an instrument through which interior structures can be seen.

ligaments: From the word "ligate," meaning "to bind or tie," ligaments connect bone to bone, not muscle to bone.

linoleic acid: A type of omega-6 fatty acid.

lipoproteins: Fat proteins.

LDL: low-density lipoprotein, fat protein that transports triglycerides from liver cells to fat cells, where they are stored; carries cholesterol in the blood and delivers it to cells throughout the body for tissue repair; and aids in the synthesis of vital chemicals, such as steroid hormones.

lutein: A carotenoid (organic pigment) associated with protection against age-associated macular degeneration.

lycopene: A carotenoid (organic pigment) found in high concentrations in the blood of healthy people; it is associated with protection against prostate cancer.

macronutrient: An essential nutrient required in relatively large amounts.

MRI: Magnetic resonance imaging, a detailed picture of the body's internal structure obtained without using X-rays.

mammoplasty: Surgical reshaping of the breast.

mantra: A word or phrase spoken repeatedly to relax the body and empty the mind.

martial arts: Arts of combat practiced as self-defense or as a sport or spiritual discipline.

maximum heart rate: A measure of anaerobic conditioning; calculated by subtracting one's age from 220.

meditation: A mental exercise designed to heighten concentration or spiritual awareness.

Mediterranean diet: A heart-healthy diet inspired by eating styles in Mediterranean countries that emphasize the consumption of healthy fats, fruits, vegetables, and fish with alcohol taken in moderation.

melanoma: A serious skin cancer.

melatonin: A sleep-regulating hormone also involved in modulating the circadian rhythms.

menopause: A phase in the life of a woman that begins 8–12 months after her menstrual periods have ceased.

menses: The menstrual cycle.

metabolic panel levels: Measures of certain compounds in the blood, such as blood sugar and electrolyte balances and calcium levels.

metabolic syndrome: A condition characterized by the presence of at least three of the following factors: abdominal or central obesity, high blood pressure, high triglycerides in the blood, low HDL cholesterol in the blood, and high blood glucose.

metabolism: All energy processes in the body, including consumption and expenditure of energy, as well as renewal of energy.

mindfulness: The awareness that arises through concentration and meditation.

minerals: Inorganic substances, such as calcium, magnesium, and potassium, required by the body in small amounts.

mitochondria: The cell's powerhouses and the source of energy in the engines of the cell.

mitochondrial enzymes: Biochemicals whose activities serve as markers of aging.

monosaccharides: Simple sugars, including glucose, galactose, and fructose.

monounsaturated fats: Fatty acids, considered heart healthy, that have only one double bond in the fatty acid chain; they are liquid at room temperature.

morbid obesity: A condition defined by being twice normal weight or 100 pounds overweight or having a BMI of more than 40.

morbidity: Nonlethal complications of a disease; rate of sickness.

mortality: Death; death rate.

motor neurons: Nerves that connect with muscle and stimulate muscle contraction.

motor unit: The combination of a single motor neuron, or nerve, and the muscles it activates.

multi-infarct dementia: Dementia caused by multiple small strokes in the brain, leading to damaged brain tissue.

myelin sheath: The protective membrane in the central nervous system.

natural menopause: The transition to total cessation of a woman's menstrual periods, which usually begins between 45 and 55 years of age and can take 5 to 10 years.

Nautilus exercise machine: A type of exercise training equipment.

neurofibrillary tangles: Buildup of proteins in the brains of Alzheimer's patients, resulting in cell death.

neuroimaging: Techniques to image the structure and functionality of the brain.

neuromuscular junction: A place in the body where the nerves meet the muscles; the point at which impulses are transmitted from the brain to the muscles.

neurons: Cells that serve as the building blocks of nervous tissue.

neuroplasticity: The brain's ability to reorganize and restructure itself by forming new neural connections.

obesity: State of excessive overweight; the third leading preventable cause of death in the United States, behind smoking and high blood pressure.

obstructive sleep apnea: A disorder in which a sleeping person's airway closes down; it causes chronic sleep deprivation and may result in serious health consequences.

omega-3 fatty acids: Highly unsaturated fats needed for the production of hormone-like compounds known as prostaglandins. A requirement for a healthy diet, they are found in coldwater fish, fish oils, and avocado.

omega-6 fatty acids: Unsaturated fats found in meat, corn oil, safflower oil, and sunflower oil; they tend to be overconsumed in the American diet and can increase inflammation, as in arthritis or in the arteries.

omenta: The apron of fat that protects internal organs.

organic: Biologic compounds or molecules found in nature that have a carbon base; may also refer to plant and animal products defined by a particular method of farming that uses no chemical pesticides and no chemical fertilizers.

osteoarthritis: Degeneration of cartilage.

osteoblasts: Cells that build up bone.

osteoclasts: Cells that break down bone and liberate calcium in the serum to compensate for low levels of calcium.

osteopenia: Low bone mass; characterized by a bone mineral density score of −1.0 to −2.5.

osteoporosis: A disorder characterized by weak and porous bones and a bone mineral density score of less than −2.5.

osteosarcoma: A serious form of bone cancer.

oxidation: A process whereby electrons are transferred from one molecule or atom to another, creating free radicals. Free radicals and oxidation reactions are a necessary part of normal host defenses, but excess oxidation reactions are damaging.

oxidative stress: The elevation of free radicals beyond the body's capability to neutralize them to safe levels. Excessive oxidative stress damages the cells and tissues, specifically the mitochondria.

palliation: Treatment of symptoms without the intent of curing the underlying disease.

parathyroid glands: Glands that produce parathyroid hormone, which stimulates the osteoclasts and controls the amount of calcium in the blood.

pear-shaped body: A body shape with more weight around the hips than around the waist.

pedicle graft: A graft in which a portion of the skin from the donor site remains attached to the donor area and the rest is attached to the recipient site, preserving the blood supply.

perimenopause: The beginning of irregularities in the menstrual cycle before the onset of menopause; also refers to the years leading up to menopause, which occurs between 8 and 12 months after the final menstrual period.

periodization: A way of dividing an exercise program into different sets that emphasize different training goals; also, a method for varying training at regular intervals.

periosteum: A covering on the bone.

Physicians' Health Study: A study designed to test the effects of aspirin and beta-carotene on cardiovascular disease and cancer.

phytoestrogens: Compounds developed from plants to mimic the effects of estrogen.

phytonutrients: Nutrient compounds that come from plants.

Pilates: An exercise system that emphasizes core strength, flexibility, and awareness of breathing.

platelet aggregation: A condition in which platelets gather in areas of inflammation or bleeding and cause clotting.

polyphenols: Common antioxidant molecules found in nature that may inhibit LDL oxidation and thereby prevent arterial plaque formation; found in red wine, grape juice, dark berries, and cherries.

polyunsaturated fats: Fatty acids that have two or more double bonds in the fatty acid chain; these fats are liquid at room temperature.

prefrontal cortex: The brain's planning center, located between the temples in the forehead and behind the eyes.

premature menopause: Early menopause brought on by various physical problems; common in women athletes, it may be related to different levels of male hormones. It also may be related to nutritional deficiencies, autoimmune diseases, and chronic stress.

probiotics: Active bacteria added to foods to promote digestive health; they can be found in yogurt. There is no evidence that these bacteria are any better than the bacteria already present in the colon.

prophylactic mastectomy: Preventive removal of the breast to protect against breast cancer.

prostate-specific antigen (**PSA**): An antigen used in screening for early, asymptomatic prostate cancer.

proteins: Complex substances made of amino acids whose main function is to build and repair tissue; proteins can be found in every tissue in the body.

psycho-oncology: A medical field that combines treatment of the psychological, emotional, and spiritual aspects of coping with a cancer diagnosis with the patient's physical care.

pyramids: A weight-training routine in which the weight is increased and the number of repetitions is decreased as one "climbs the pyramid"; the weight is then reduced and the repetitions are increased as one "descends the pyramid."

recommended daily allowance (RDA): The recommended daily dietary intake sufficient to meet the requirements of nearly all healthy individuals.

reconstructive surgery: Surgical procedure performed with the primary aim of improving function.

recovery time: The rest period after exercise that is essential to muscle and tissue repair and strength building.

relative risk: *See* **absolute risk.**

REM sleep: Rapid eye movement sleep, a period of sleep during which dreams occur; characterized by increased brain activity.

resistance training: Strength training that uses weights or other forms of resistance, such as elastic bands.

respirometer: An instrument for measuring the rate of respiration (exchange of oxygen and carbon dioxide).

resting pulse: The resting heart rate measured immediately after waking up in the morning and before getting out of bed.

resveratrol: An antioxidant polyphenol molecule produced by plants in response to their own stress; found in grape skins, grape juice, and red wine.

reverse osmosis purification system: Filtration method used for purifying water in which water is forced through a semipermeable membrane.

rhabdomyolysis: Breakdown of muscle tissue that releases myoglobin into the blood and thus can damage kidneys.

rheumatoid arthritis: Chronic joint inflammation that mainly attacks the joints in the hands and feet.

rickets: A calcium- and vitamin D–deficiency disease that damages bones.

RNA (ribonucleic acid): A type of molecule that plays a role in controlling the cell's chemical activities, including protein synthesis and transmission of genetic information.

satiety index: A system to measure the extent to which foods signal that you are full after eating.

saturated fats: Long carbon–fatty acid chains that have no double bond because the whole molecule is saturated with hydrogen ions. Saturated fats are solid at room temperature.

screening: A test for the presence of disease performed in the course of routine health care, regardless of whether the patient has symptoms or indications of illness.

sebum: The secretion from sebaceous (oil-producing) glands.

second-class lever: A lever that has its point of resistance (weight) between the fulcrum and the point of effort; the type used when a person stands on tiptoe.

secondhand smoke: Smoke that a smoker exhales and that another person breathes in after it has been diluted in the air.

selective estrogen receptor modulators: Synthetic molecules that can bind to estrogen receptors in the body and have estrogen-like effects on some parts of the body (e.g., bone) and antiestrogen effects in other areas (e.g., breast).

sepsis: A severe infection.

serum lipid profile: A blood test to determine risk of heart disease; measures levels of cholesterol, HDL, LDL, and triglycerides.

simple set: A certain number of repetitions of an exercise performed three times. For example, 10 bicep curls may be performed as one set.

sirtuins: Silent information regulator 2 (or SIR2) proteins, a group of molecules that regulates important biologic pathways, including metabolic processes and cell defenses, in many organisms, from bacteria up through more evolved organisms.

skeletal muscles: Striated muscles that enable movement and support the skeleton.

Slow Food Movement: A movement opposed to fast food that encourages local food traditions and less-intensive farming methods.

smooth muscles: Involuntary muscles found in the stomach, intestines, blood vessels, and bladder.

staging: A method of grouping cancer cases in categories based on the degree to which the cancer has spread.

standing bow-pulling pose: A yoga pose thought to increase circulation of the blood to the heart and lungs.

static stretching: Flexibility training in which the muscles are stretched while the body is at rest. *See also* **dynamic stretching**.

statin: A drug that blocks cholesterol production in the liver.

stent: A prosthetic device designed to keep a widened artery open.

striated muscles: Voluntary muscles connected to bone that move parts of the skeleton; characterized by transverse stripes.

stroke volume: The amount of blood pumped out of the heart on each beat.

subperiosteal hematomas: Tiny hemorrhages under the covering of the bones, often caused by running.

sulfenic acid: A powerful antioxidant; a byproduct of the decomposition of allicin.

super sets: Exercise routines in which the individual alternates different kinds of exercises for the same muscle group.

superoxide radicals: Free radicals that tend to oxidize and provoke oxidative stress, damaging cells and tissues.

synapse: The point at which an impulse passes from one neuron to another.

synergy: A mutually advantageous situation in which the total result is greater than could be achieved by the individual elements.

synovial lining: The lining of the joint.

Tabata protocol: A workout that consists of 20 seconds of high-intensity exercise, such as sprinting, followed by 10 seconds of rest, repeated six or seven times.

tae kwon do: Korean art of self-defense characterized by kicks.

tai chi chuan (a.k.a. **tai chi**): A slow-motion, meditative exercise derived from Chinese martial arts.

tendinitis: Inflammation of a tendon.

tendon: Connective tissue that unites the muscle to the periosteum (covering of the bone). It is derived from the word *tendere*, "to stretch."

testosterone: The hormone produced in men's bodies that affects sexual features and development.

thimerosal: A mercury-containing preservative that was once used in vaccines.

third-class lever: A lever with its force application (point of effort) between the fulcrum and the resistance. An example would be the bent elbow in a weight-lifting exercise.

thirdhand smoke: The residue of tobacco products, including gases and particles, that remains in an environment after the airborne smoke has dissipated.

thrombolytic therapy: Use of drugs that can dissolve blood clots.

trans-fats: Unsaturated fats that have been hydrogenated so that they are more appropriate for baking and have increased shelf life.

transcription factor: A protein that controls the transfer of genetic information and plays an important role in cellular processes.

transient ischemic attacks (**TIAs**): Mini strokes.

triglycerides: Dietary fats composed of three fatty acids together with one molecule of glycerol. More than 90 percent of the fat in the body is in this form, as is most of the fat in food.

tryptophan: A precursor to melatonin, which is a sleep-regulating hormone; tryptophan is sometimes used to treat insomnia.

tumeric: A spice whose active component is curcumin, an antioxidant and anti-inflammatory.

tumor suppressor genes: Genes that help the body naturally fight off and prevent cancer.

type 1 diabetes: Sometimes called juvenile diabetes, an autoimmune disorder in which the individual does not produce any insulin because the beta cells do not function; patients must take insulin throughout their lives.

type 2 diabetes: Also called adult-onset diabetes, this is the more common form of diabetes, in which the body produces insulin but does not use it effectively. Diagnosed in those with a fasting blood sugar greater than 126 milligrams per deciliter or an oral glucose tolerance test greater than 200.

type I muscle fibers: Slow-twitch muscle fibers that use oxygen for energy and are extremely fatigue resistant. They are found, for example, in postural muscles.

type II muscle fibers: Fast-twitch muscle fibers characterized by quick contraction time. Type IIA fibers are fast oxidative fibers, which are less fatigue resistant and are typical of a sprinter's muscles. Type IIB fibers are fast glycolytic fibers that operate with the production of lactic acid instead of oxygen and carbon dioxide. They are used for explosive bursts of activity and fatigue easily.

unsaturated fats: Fats in which double bonds exist between the carbon molecules; they take the form of monounsaturated and polyunsaturated fats.

Valsalva maneuver: A technique of forcing air against a closed airway to test cardiac function.

vascular dementia: A common type of dementia caused by impaired blood flow to the brain. It may be brought on by a stroke, meaning that an artery is closed. It may also occur after a series of small strokes that block vessels.

venous thromboembolism: A condition in which blood clots migrate to the lung.

ventricular fibrillation: Rapid, erratic heartbeats that result in the ventricles' failure to pump blood; lethal arrhythmia.

visceral fat: Belly fat inside the abdomen.

visceral organs: The organs inside the abdomen and around the belly.

vitamer: One of two or more related chemical substances that fulfills the same specific vitamin function.

vitamins: Organic chemical compounds that the body must obtain from external sources because they cannot be manufactured internally.

VLDL: Very low-density lipoprotein. *See* **LDL**.

VO_2 max: An indicator of aerobic endurance—the maximum volume of oxygen (O_2) that an individual can use during exercise, measured in liters of oxygen per minute.

warrior pose: A yoga pose that strengthens the legs and opens the chest and shoulders.

weight training: The practice of lifting weights or pushing against resistance to build muscles.

yoga: A system of exercises, originating in India, designed to promote well-being of the body and mind.

zazen: Zen meditation.

Zen Buddhism: A school of Buddhism that focuses on meditation as the path to enlightenment.

Bibliography

Note: Professor Goodman neither endorses nor necessarily agrees with all content in the websites listed in this bibliography. He lists them as starting places—resources that may have some valuable information or further links. In the world of medicine, information changes quickly; on the Internet, websites change quickly, as well. Be discriminating and discerning and use these sites to work for you.

If a website is marked with an asterisk, some of its contents are free and no login is required, but if you sign up (and sometimes pay), you will receive newsletters, full access to archives, and other bonus materials.

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