

The aging body



**If chronic disease is not
a natural part of aging,
what is? This overview
puts normal aging under
the microscope**

Life expectancy in the United States rose dramatically in the 20th century, from about 47 years in 1900 to about 73 years for males and 79 years for females in 1999. This increase is mostly due to improvements in environmental factors—sanitation, the discovery of antibiotics, and medical care. Now, as scientists make headway against chronic diseases like cancer and heart disease, some think life expectancy can be extended even further in the 21st century.

Chronic diseases and disabilities were once thought inseparable from old age. This view is changing rapidly as one disease after another joins the ranks of those that can be prevented or at least controlled, often through changes in lifestyle.

We now know, for example, that most people can avoid lung disease by not smoking. And heart disease and stroke rates have fallen at the same time that Americans have lowered their fat consumption, begun to exercise more and quit smoking.

So if chronic disease is not intrinsic to the aging process, as many gerontologists now believe, then what is? Are there universal or *normal* aging processes?

What is normal aging?

Today, gerontologists are discovering that age in years doesn't necessarily correlate with physiological age. In fact, normal physiological aging is quite variable, according to investigators involved in the Baltimore Longitudinal Study of Aging, a long-term National

Institute on Aging (NIA) study begun in 1958 that has tracked the lives of more than 1,000 people from age 20 to 90 and beyond.

Not only do individuals age overall at vastly different rates, it is quite likely that age-related changes in various cells, tissues and organs differ as well. For instance, kidney function may decline more rapidly in some individuals. In others, bone strength may diminish faster. The organs that age fastest in one person may not age as rapidly in another. This suggests that genes,

lifestyle and disease can all affect the rate of aging and that several distinct processes are involved.

Even within one person, organs and organ systems show different rates of decline. However, some generalities can be made, based on data from the NIA study.

Heart. Heart muscle thickens with age. Maximal oxygen consumption during exercise declines in men by about 10% with each decade of adult life and in women by about 7.5%. This decline occurs because the heart's maximum pumping rate and the body's ability to extract oxygen from blood both diminish with age.

Cardiovascular capacity predicts longevity better than risk factors such as obesity, heart disease and smoking, according to a study published in the *New England Journal of Medicine* in 2002. A research team led by Dr.

Jonathan Myers, of Veterans Affairs Palo Alto Health System in California, concludes that "peak exercise capacity measured in metabolic equivalents (MET) [is] the strongest predictor of the risk of death among both normal subjects and those with cardiovascular disease" after adjusting for age. Furthermore, a landmark Texan study shows aerobic exercise can improve cardiovascular fitness dramatically even after three decades of inactivity. Published in *Circulation* in 2001, the research outlines how six months of endurance training led to a 100% reversal of age-related declines in aerobic power in midlife men.

Arteries. Arteries tend to stiffen with age. The older heart, in turn, needs to supply more force to propel the blood forward through the less elastic arteries, causing high blood pressure and enlarging the heart. Both are serious risk factors for heart disease. After menopause, women are at especially high risk.

But exercise can make older women's arteries more pliable when combined with hormone replacement therapy (HRT), according to Dr. Kerrie Moreau of the University of Colorado Human Cardiovascular Research Laboratory in Boulder. At the 2002 Experimental Biology meeting, Dr. Moreau discussed a study she had conducted with women on HRT, all of whom were about 60 years-old, somewhat overweight and relatively inactive. For 13 weeks, the participants walked at a moderate pace five days a week for 40–45 minutes. At the study's end, the elasticity of the women's arteries had improved by almost 50%, restoring them to premenopausal levels.

Lungs. Maximum breathing (vital) capacity may decline by about 40% between the ages of 20 and 70. After age 30, the rate of airflow through the airways gradually deteriorates, while the maximal force achieved when breathing



in and out also lessens. Even among the *oldest old*, breathing generally stays adequate as people age, except when the need arises for increased breathing capacity, at which time the lungs may struggle to keep up. The most effective way to minimize the impact aging has on the lungs is to avoid smoking. However, exercise can also help by increasing the lungs' reserve capacity, according to many research studies.

Brain. With age, the brain loses some of the structures (axons) that connect nerve cells (neurons) to each other, although the actual number of neurons seems to be less affected. The ability of individual neurons to function may diminish with age. Recent research indicates that the adult nervous system is capable of producing new neurons, but the exact conditions that are critical for this have yet to be determined.

When a person stays physically fit, three key areas of the brain adversely affected by aging show the greatest benefit, according to researchers from the University of Illinois at Urbana-Champaign. These investigators have found anatomical differences in the brain's gray and white matter between physically fit and less fit older adults. The findings "provide the first empirical confirmation of the relationship between cardiovascular fitness and neural degeneration," says lead author Arthur F. Kramer, a professor of psychology and member of the Beckman Institute for Advanced Science and Technology at Illinois. "It is fitness as it interacts with age that has the positive effects," says Kramer. "Older adults show a real decline in brain density in white and gray areas, but fitness actually slows that decline."

Published in the February 2003 *Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, the study findings also reveal that cardiovascular

exercise and strength training produce better results on cognitive abilities when combined, than either does alone. Older exercisers reap more benefit than their younger counterparts, say the investigators, possibly because older adults have more to gain due to age-related declines. Finally, individuals who exercise for more than 30 minutes per session experience the greatest benefits.

A 2002 study in the *Journal of the American Medical Association* suggests it's possible to slow aging-related declines in mental ability. Dr. Karlene Ball of the University of Alabama at Birmingham and colleagues have evaluated nearly 3,000 adults given training in memory, reasoning and speed of processing. Participants ranging in age from 65–94 years show immediate improvements in the cognitive abilities targeted by each intervention. They also appear able to maintain these improvements for up to two years.

Kidneys. With age, the kidneys gradually become less efficient at extracting wastes from the blood, as evidenced by an increasing incidence of kidney disease. Data from the National Center for Health Statistics show that just 0.6% of America's youngest adults, those ages 18–24 years, have kidney disease, compared to 5.5% of the oldest adults, those ages 85 and older. For most older adults with kidney disease, exercise is safe and has a positive impact on health. And research appears to support the physical and psychological benefits even gentle exercise offers individuals with chronic renal failure. However, those with kidney disease require tailored exercise programs that take into account their needs, such as increasing exercise gradually and accommodating anemia.

Bladder. Bladder capacity declines. Urinary incontinence, which may occur

after tissues atrophy, particularly in women, can often be managed through exercise and behavioral techniques. The layers of muscle that stretch between the legs at the bottom of the pelvis attach to the front, back and sides of the pelvic bone. Just five minutes of pelvic floor muscle exercises three times daily can strengthen the muscles that prevent urine leakage, according to the National Institute of Diabetes and Digestive and Kidney Diseases. By toning the muscles responsible for holding the bladder and other organs in place, older adults can significantly improve bladder control.

Body fat. Typically, body fat gradually increases in adulthood until individuals reach middle age. Then it usually stabilizes until late life, when body weight tends to decline. As weight falls, older individuals tend to lose both muscle and body fat. With age, fat is redistributed in the body, shifting from just beneath the skin to deeper organs. Women typically have a higher percentage of body fat than men. However, because of differences in how this fat is distributed—on the hips and thighs in women and on the abdomen in men—women may be less susceptible to certain conditions including heart disease.

But public health officials are concerned about older adults' rising levels of obesity (defined as a body mass index of 30 or greater). Table 1 on page 39 reveals the prevalence of overweight and obesity in the older adult population, as reported in the National Center on Health Statistics' annual report, *Health, United States, 2003*. In fact, obesity levels among individuals ages 50 or older have more than doubled in the last two decades, according to AARP, a nonprofit membership organization that serves older adults.

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“Morbidity from obesity may be as great as from poverty, smoking or problem drinking,” states a June 2002 report by the U.S. Department of Health and Human Services (HHS). “Overweight and obesity are associated with an increased risk for developing various medical conditions including cardiovascular disease, certain cancers (endometrial, colon, postmenopausal breast, kidney and esophageal), high blood pressure, arthritis-related disabilities and type 2 diabetes,” continues the report, *Physical Activity Fundamental to Preventing Disease*. Regular physical activity and a nutritious diet are essential to help older adults maintain a healthy weight and reduce their health risks.

Muscles. Without exercise, estimated muscle mass declines 22% for women and 23% for men between the ages of 30 and 70. To this loss, add strength declines of 50% and power reductions of 75%, and it’s easy to understand how many older people lose their functional independence. Exercise can slow the rate of loss of muscle mass, strength and power.

The seminal paper on strength training and aging was published in the *Journal of the American Medical Association* in 1990. Maria Fiatarone, Bill Evans and other researchers from Tufts University in Boston studied frail adults, average age 90, who participated in eight weeks of high-resistance weight training. The nine individuals who completed the study averaged muscle strength gains of 174% and mid-thigh muscle size increases of 9%. Mean tandem gait speed also improved by 48%.

In 1994, Fiatarone, Evans and colleagues published a landmark study in the *New England Journal of Medicine* about the effects of strength training on frail older adults. Of the 100 nursing home residents ages 72–98 years-old



who participated in the study, 94 completed the high-intensity strength training program. In just 10 weeks, these frail individuals saw increases in muscle strength of 113% and cross-sectional thigh muscle of 2.7%. The researchers also noted significant improvements in gait velocity and stair-climbing power.

Once older adults have increased their strength and muscle mass, they can maintain this improvement with relatively little effort. A study conducted by Scott Trappe and colleagues from Ball State University in Indiana shows that these gains can be preserved with one weekly training session involving three sets of 10 repetitions at 80% of one rep. max. Trappe et. al.’s research was published in 2002 in the *Journals of Gerontology Series A: Biological Sciences and Medical Sciences*.

Bones. Bone mineral is lost and replaced throughout life; loss begins to outstrip replacement around age 35. This loss accelerates in women at menopause. Regular weight-bearing exercise—walking, running, strength training—can slow bone loss.

Osteoporosis is a significant threat for about 44 million Americans, according

to the National Osteoporosis Foundation (NOF). Currently, this bone-thinning disease affects an estimated 10 million individuals—four in five of whom are women. A further 34 million people ages 50 or above, or 55% of older adults, have osteopenia, or low bone mass, which places them at increased risk of fracture and of osteoporosis.

Bone mineral density (BMD) tests can tell healthcare providers whether a person already has the disease, or is at risk, *before* a fracture. This knowledge allows healthcare providers to create an osteoporosis prevention or treatment program for the individual. According to NOF, program components may include weight-bearing physical activity, calcium and vitamin D supplementation, changes in lifestyle (i.e. giving up smoking), medications and BMD tests. Both NOF and the American College of Sports Medicine recommend weight-bearing and resistance exercise to prevent osteoporosis.

Sight. Difficulty focusing close up may begin in the 40s; the ability to distinguish fine details may begin to decline in the 70s. From 50 on, there is increased susceptibility to glare, greater difficulty in seeing at low levels of illumination, and more difficulty in detecting moving objects.

Hearing. It becomes more difficult to hear higher frequencies with age. Even older individuals who have good hearing thresholds may experience difficulty in understanding speech, especially in situations where there is background noise. Hearing declines more quickly in men than in women.

Personality. Personality is extraordinarily stable throughout adulthood. Generally, it does not change radically, even in the face of

major events in life such as retirement, job loss, or death of loved ones. However, there are exceptions. Certain individuals facing these and other life-altering circumstances can and do show signs of personality change during the final years of life. An easy-going individual who loses a job after many years, for instance, may become disillusioned and develop a sullen disposition. But these out-of-character reversals of personality are relatively rare.

Not aging, but disuse

“Much of what we think about aging is not aging, but disuse,” says Dr. Walter Bortz of Stanford University Medical School. To explain *disuse*, the past president of the American Geriatrics Society uses the analogy of a leg in a cast. Although the leg shrivels, weakens and looks old, it doesn’t *age*. That “old-looking, old-functioning leg” will become vital and active again with exercise, but it won’t become *younger*.

According to Bortz, there are only two proven ways for humans to “look and feel younger” and reduce the risks of dying or age-associated diseases: engaging in regular exercise and eating a healthy diet.

Health and wellness professionals are essentially partners with older adults who want to maintain a youthful vitality. By learning more about the aging process, those who work with older clients can provide programming that helps these individuals enjoy a vibrant, independent and active lifestyle for as long as possible. ▼

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Table 1. Prevalence of overweight and obesity among older Americans, 1999–2000.

| | Overweight (BMI 25 or above) | Obesity (BMI 30 or above) |
|--|---------------------------------|------------------------------|
| Men | | |
| 55–64 years | 72.5 | 32.9 |
| 65–74 years | 77.2 | 33.4 |
| 75 years & over | 66.4 | 20.4 |
| Women | | |
| 55–64 years | 73.1 | 43.1 |
| 65–74 years | 70.1 | 38.8 |
| 75 years & over | 59.6 | 25.1 |
| Reference | | |
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