



Health & Nutrition Letter

THE FRIEDMAN SCHOOL OF NUTRITION SCIENCE AND POLICY

YOUR GUIDE TO LIVING HEALTHIER LONGER

10 Determinants of Aging You Can Control

THE OLD SAYING THAT “you’re only as old as you feel” turns out to have some scientific merit. As researchers at centers such as Tufts’ Jean Mayer USDA Human Nutrition Research Center on Aging (HNRCA) probe the secrets of how we age, they continue to find ways in which our *biological* age influences our health and quality of life more than our *chronological* age. The good news is that, while you can’t turn back the calendar, you *can* do something to affect your biological age—the toll the years take on your body and your health.

To put it another way, your lifespan—how many years you live—is important, but perhaps not as much so as your health span: that period of your life when you’re functional and able to perform everyday life tasks for yourself. Isn’t that what most of us want more of in our lives—not merely years but good, independent, enjoyable years?

One of the programs for slowing the aging process and adding strength and vitality to your life was laid out 15 years ago in the then-revolutionary book *Biomarkers: The 10 Determinants of Aging You Can Control*. The book was written by two Tufts professors, William J. Evans, PhD, and Irwin H. Rosenberg, MD, with Jacqueline Thompson, and published by Simon & Schuster in 1991. Evans was then chief of the Human Physiology Laboratory at the HNRCA. Dr. Rosenberg was then the director of the HNRCA and subsequently became dean of Tufts’ Friedman School of Nutrition Science and Policy. He’s now a University Professor and the editor of the *Healthletter*.

How well does that 15-year-old program for controlling much of your own aging process stand the test of time? While research has of course added to our knowledge about all 10 of the “biomarkers” described in the book, the basic lessons still hold true today. As the authors note, “Our research, and that of others, shows that people can reverse—or at the very least retard—many of the physiological declines associated with aging without turning their lives inside out and upside down.”

While diet fads have come and gone in the intervening decade and a half, and researchers have filled in many of the gaps in our knowledge of how the body ages, the bottom line of *Biomarkers* remains as true now as then: Exercise is the key to a healthy and rewarding old age. Even for the frail elderly—and this is still a bold concept—a regular exercise program can have a strong positive health impact. A combination of regular aerobics, flexibility and strength training is

the best strategy for retarding—even reversing—the effects of aging on the 10 biomarkers the authors identify.

Since the publication of *Biomarkers*, subsequent research has continued to support this basic premise. Consider, for example, the research-based recommendations of the latest federal dietary guidelines, released last year: In addition to prescriptions for a healthy diet, the guidelines include goals for exercise, calling for a minimum of 30 minutes of exercise daily—and 60 minutes a day of moderate to vigorous exercise to keep from gaining weight. To lose weight, the guidelines suggest up to 90 minutes a day of physical activity, which could include walking, bicycling, hiking, even gardening.

But 15 years ago, the idea that exercise could benefit even the frail elderly was still revolutionary. That’s only one of the many commonly held myths about aging that researchers at the HNRCA and other centers have dispelled. Aging does not have to be synonymous with illness or disability. The onset of most chronic degenerative conditions we associate with old age is governed by your genetic heritage—which you’re stuck with—and your lifestyle, which you *can* do something about. By making positive changes in your own biomarkers through a combination of exercise and eating right, you can:

- **Prolong vitality** by slowing or even reversing the biological deterioration processes that people typically start to suffer after about age 45, such as declining strength, glucose intolerance and metabolism slowdown.

- **Postpone disability** by reducing your risk of such chronic conditions as heart disease, type II diabetes, arteriovascular disease, hypertension and osteoporosis.

- **Prevent the development of** a common old-age malady the authors dubbed “**sarcopenia**”—a weakening of the body’s muscles, particularly in the legs, with a loss of muscle mass and replacement by fat. The ultimate price of this condition is loss of balance, reduced mobility and the frailty so often seen in the elderly.

“**Biointervention**”—making lifestyle changes that positively affect your biomarkers—won’t make you live forever, but it can postpone—sometimes by decades—your entry into what the authors call the “**Disability Zone**.” Instead of dropping sharply into disability with age, like rolling down a steep hill, an active lifestyle can help you slow and “flatten” that descent into decline.

A crucial first step toward making the lifestyle changes essential to extending your health span is understanding these **10 biomarkers**—each sensitive to your exercise and

activity level—that determine your biological age:

1. Your Muscle Mass—The average middle-aged person’s problem is not excess weight as much as it is excess body fat coupled with too little muscle. Simply losing weight is the wrong goal; the key is changing your ratio of body fat (biologically inactive energy storage) to muscle (biologically active tissue). People with a greater ratio of muscle to fat enjoy a higher metabolism and don’t have to worry as much about gaining weight or about how much they eat—that active tissue burns more calories.

Most people’s muscle mass declines with age, and the rate of loss accelerates after age 45. The amount of muscle you have—and that you retain—is determined in part simply by how much you use your muscles. If you use your muscles frequently, you can maintain their strength. But if you push your muscles to the limits of their capacity by exercise, you can actually increase their strength—no matter your age.

2. Your Strength—As you age, you lose whole “motor units”—sets of muscles and nerves that work together to make your body go. For example, between ages 30 and 70, it’s been estimated, people typically experience a 20% decrease in the number of motor units in the thigh.

Aging also brings a decline in “fast-twitch” muscle fibers—the kind you

The Borg Scale

You can score the intensity of your exercise effort using the Borg Scale, named for Swedish exercise physiologist Gunnar Borg. On the scale, a rating of 6 equals no exertion; a rating of 20 represents a supreme effort, pushing yourself to the limit of endurance. Your goal in a long-term exercise program should be to exercise at an intensity of about 15.

Rating	Verbal Description of Your Exertion
6	None
7	Very, very light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Very, very hard
20	

Verbal Description of Your Exertion

None
Very, very light
Very light
Fairly light
Somewhat hard
Hard
Very hard
Very, very hard

use to lift heavy objects or to do high-intensity, sprint-type activities. This slows you down and partially accounts for age-related loss of strength.

But a decline in muscle strength and size is not inevitable. Landmark research at Tufts in the 1980s debunked the conventional wisdom that age somehow decreases the ability of muscles to benefit and get bigger from strength training, such as weight lifting. So don’t think that you’re “too old” for strength training. The fact is that you can regain muscle mass and strength, no matter your age or what shape you’re in now.

3. Your Basal Metabolic Rate (BMR)—This simply means the rate of your body chemistry—your metabolism—when you’re at rest (“basal,” as in “baseline”). Like other essential measures, your BMR declines with age and you burn fewer calories when your body isn’t in motion. From about age 20 on, every decade that you age reduces the amount of calories you need to maintain a constant body weight by roughly 100 calories. So a typical 70-year-old needs 500 fewer daily calories than a 20-year-old.

need to exercise to increase your muscle and turn back the clock on your BMR.

4. Your Body Fat Percentage—Even if your body weight hasn’t gone up that much as you’ve gotten older, you’ve probably gained fat. As your musculature shrinks, fat tissue accumulates. Since muscle tissue weighs more than body fat, that number on your bathroom scale can be deceiving. Instead of focusing on losing weight, concentrate on gaining muscle and shedding fat.

While it’s not the same as your body fat percentage, your Body Mass Index (BMI) can still be a useful tool in measuring your risk for developing the chronic diseases associated with aging. You can calculate your BMI by entering your height and weight at any number of Web sites, such as the one at the National Heart, Lung and Blood Institute’s (NHLBI) page <nhlbisupport.com/bmi>. While BMI is often used as a shorthand measure of overweight or obesity, it’s important to recognize that your “ideal BMI”—the figure associated with the lowest risk of chronic disease or mortality—changes with age:

“Ideal” BMI		
Age range	Male	Female
20-29	21.4	19.5
30-39	21.6	23.4
40-49	22.9	23.2
50-59	25.8	25.2
60-69	26.6	27.3
70-79	27.0	27.8

For the elderly, a slightly higher BMI seems to be protective; think of elderly people you know who seem to be “wasting away” and are vulnerable to disease. Professional athletes can also get away with a higher BMI, because their body-fat levels are so low. The rest of us, though, need to watch it.

You should also watch your waistline, as studies have shown that the *distribution* of body fat may be an even better predictor of the risk of chronic disease and mortality. It’s healthier to be shaped like a pear—

with more body fat stored below the hips—than like an apple, with fat stored above the hips. Developing a pot belly, in short, increases your risk. Recently, researchers using data from the worldwide Interheart study found that waist-to-hip ratio was three times more effective than BMI in predicting cardiovascular risk. To figure your own ratio, simply divide your waist measurement by your hip measurement; so, for example, a 36-inch waist and 40-inch hips would be a ratio of 0.9. Anything over 0.85 for women and 0.9 for men indicates greater risk for heart disease, according to these findings. (See the January 2006 *Healthletter*.)

If you *combine* a high BMI with a high waist-to-hip ratio, your risk is magnified. This chart from the NHLBI shows how risk for cardiovascular disease, type-2 diabetes and hypertension increases as BMI and waist circumference grow:

	BMI	Obesity Class	Men 40" or less Women 35" or less	Men greater than 40" Women greater than 35"
Underweight	< 18.5			
Normal	18.5-24.9			
Overweight	25.0-29.9		Increased	High
Obesity	30.0-34.9	I	High	Very High
	35.0-39.9	II	Very High	Very High
Extreme Obesity	40.0+	III	Extremely High	Extremely High

So what can you do if you don't like what this biomarker is telling you? The best way to attack excess body fat is a combination of exercise and moderate caloric restriction. By adding exercise to a "weight-loss" diet, you'll maintain muscle mass while you lose fat tissue, raise your metabolic rate and, of course, burn more calories.

5. Your Aerobic Capacity—How much oxygen can your body process within a given time? That's your aerobic capacity, for which you need healthy lungs, a strong heart and an effective vascular network. Here's another biomarker that naturally declines with age in most people: In both men and women, aerobic capacity at age 65 is typically 30-40% less than in young adults. But older people who exercise regularly lose less of

their aerobic capacity.

Researchers have found, however, that while both young and older people benefit from regular aerobic exercise—the kind that makes you huff and puff—the positive changes in older people come almost entirely in the muscles' ability to utilize oxygen ("oxidative capacity"), rather than in the heart or cardiovascular system. That's another reason why you need strengthening exercises as well as aerobic activity: When you build muscle, you create more muscle cells to consume oxygen. The more demand for oxygen from your muscles, the greater your utilization of oxygen and your aerobic capacity.

6. Your Body's Blood-Sugar Tolerance—"Glucose tolerance" means your body's ability to control blood sugar (glucose). Aging takes a toll on your ability to use this sugar from your bloodstream, though you probably

don't realize it—like hypertension, impaired glucose tolerance displays no symptoms. By age 70, some 30% of women and 20% of men have an abnormal glucose-tolerance curve, increasing their risk of developing type-2 diabetes. This creeping blood-sugar intolerance can be among the most devastating changes associated with aging.

While aging is one factor in the changing of your glucose metabolism for the worse, so are three factors you can control:

- increased body fat
- inactivity
- a diet high in fat.

Combining a proper diet, low in fat and high in raw vegetables and whole grains, with regular workouts can often transform what was previously an insufficient amount of insulin—which stimulates muscle cells to utilize glucose

from the blood—into an adequate amount. Strength-training exercises are especially critical to reinvigorating your body's glucose tolerance and lowering your diabetes risk; besides helping to lower body fat, strength-building exercise has been shown to increase your muscles' insulin sensitivity.

7. Your Cholesterol/HDL Ratio—You probably already know that not all cholesterol in the blood is bad for you; that's why you'll often see HDL-cholesterol labeled "good" and LDL-cholesterol parenthetically explained as "bad." So it stands to reason that a low *total* cholesterol level offers no guaranteed protection against heart disease. Your goal, rather, should be to raise HDL-cholesterol while lowering LDL-cholesterol levels in your blood.

An easy way to compute how you're doing is to figure your total cholesterol/HDL ratio: Simply divide your total cholesterol number by your HDL count. For middle-aged and older men and women, the total cholesterol/HDL ratio goal should be 4.5 or lower.

As you age, your HDL level tends to remain constant, while the harmful components of blood cholesterol increase—boosting your total cholesterol and thus your total cholesterol/HDL ratio. You can work to lower the harmful LDL-cholesterol by changing your diet, especially by reducing the amount of saturated fat you consume. But dietary changes can significantly improve only one side of the equation; to boost your HDL-cholesterol levels, you need to also exercise and lower your body fat. Aerobic exercise in particular seems to be effective in raising HDL-cholesterol levels.

8. Your Blood Pressure—The importance of controlling your blood pressure should come as no surprise. What may surprise you is that an increase in blood pressure with age is not inevitable: Many populations around the world show no increase in blood pressure with age. In the US, however, our deleterious health habits pave the way for hypertension.

You can help defend against hypertension by reducing the salt in your diet (see the Special Supplement in the

February 2006 *Healthletter*). But regular, vigorous exercise can also help prevent and even treat high blood pressure.

9. Your Bone Density—With age, the mineral content of your bones declines, leaving you with a weaker, less dense, more brittle skeleton. On average, a person loses approximately 1% of bone mass per year. When this loss reaches the point where your fracture risk is substantially higher, it's called "osteoporosis," a condition that can affect men as well as women. But osteoporosis isn't an inevitable consequence of aging.

The effectiveness of calcium supplements against osteoporosis—the subject of a great deal of publicity in recent years—remains a matter of scientific inquiry, as you'll read elsewhere in this issue. But there's another way to fight osteoporosis that's received less attention, even though it may be more effective, whatever your calcium intake: exercise.

Early evidence of the importance of physical activity to bone strength came from studies of the effects of a *lack* of activity: Subjects who spent two weeks in complete bed rest showed as much bone calcium loss as ordinarily seen from a full year of aging—a 50-fold increase in the normal rate of bone mineral loss. That accelerated loss stopped when bed-rest patients were made to stand for some time every day, even if they didn't walk, apparently simply from the effect of the stress of gravity on their bones.

Stress repeatedly placed on a bone causes it to grow stronger. A number of studies have shown that a prolonged span of weight-bearing exercise—such as walking, running or cycling—can reduce the rate of bone loss. Research at Tufts has further shown that exercise may help foster the body's calcium absorption.

The evidence strongly suggests, in short, that a brisk daily walk can be a crucial factor in preventing the development of osteoporosis.

10. Your Body's Ability to Regulate Its Internal Temperature—Your body comes with a built-in thermostat, which works to cool you off by sweating

when you're hot or by shivering when you're cold. But this important thermoregulatory ability diminishes with age, due to a complex set of body changes:

- Older people have a reduced sensation of thirst, so they often fail to replenish fluids lost by sweating.
- Older people require a warmer internal temperature before they start sweating.
- Reduced kidney function contributes to dehydration and thermoregulatory problems.
- Lower fitness and aerobic capacity mean that older people have a lower rate of sweating.

Staying in shape probably can't improve your thirst mechanism, but it can reduce your risk of dehydration injuries. That's because people who exercise regularly have a higher total body water content, sweat more when they work out in the heat, and lose fewer electrolytes (potassium, chloride, sodium) when they sweat. Nonetheless, the older you are, the more fluids you should force yourself to drink—even when you don't "feel thirsty."

These 10 biomarkers represent vital elements of the aging process that

you can control. A short "health span" and a long period of disability need not be inevitable aspects of aging as our life spans increase. By beginning an exercise program now—whatever your age—and coupling increased physical activity with a healthful diet, you can influence all 10 biomarkers for the better.

Science still hasn't discovered a "fountain of youth," but the ideas originally laid out in Biomarkers continue to show a path toward maintaining a more youthful body and quality of life even as your calendar years add up. By following such a program for the rest of your life, you can greatly improve your odds of approaching the ideal: a health span that almost matches your lifespan.

TO LEARN MORE: *Biomarkers: The 10 Determinants of Aging You Can Control* by William Evans, PhD, and Irwin Rosenberg, MD, with Jacqueline Thompson (Simon & Schuster). *Growing Stronger: Strength Training for Older Adults* by Tufts University and the Centers for Disease Control and Prevention (order at www.tuftsbooks.com). *Fitness over Fifty* by the National Institute on Aging (order at www.tuftsbooks.com). Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University <www.hnrc.tufts.edu>. ♦

Building a Bioaction Plan

Describing a complete exercise plan is of course beyond the scope of this article, but here are some important points to keep in mind as you develop your exercise strategy:

- Check with your physician before beginning any new exercise regimen.
- Track your exercise routine using a log book. Structure and formality are important, especially early on as you're developing new habits.
- Begin with five minutes of low-intensity aerobic warm-up—such as simply walking around—followed by five minutes of stretching. If you have time, do another five minutes of stretching at the end of your exercise session.
- Strength training is really the key to the *Biomarkers* program. When strength training, you'll typically perform several sets of up to a dozen repetitions. As your strength increases, add weight or intensity, not repetitions. To be effective, strength training must be progressive, or you won't get the full benefits; as the intensity of your activity increases, so will your strength.
- Isotonic exercises, which aim at the muscles and joints and encompass strength-building as well as flexibility-oriented exercises, complement other forms of exercise, with combined benefits greater than you'd achieve from doing just one type of activity.
- Aerobic exercise—activity that gets you huffing and puffing—should also be a component. Examples include brisk walking, jogging, cycling, swimming, aerobic dance, cross-country skiing, skipping rope and many recreational sports. Anaerobic exercise (meaning "without oxygen")—short, exhaustive bursts of activity such as sprinting—need not be part of your program.
- Alternate your strength-training and aerobic workouts. Aim for an intensity level of 15 ("hard") on the Borg scale (see page 2).