

Special Report: Fight Age With Muscle

By John Brandt, Best Life

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*"The sixth age shifts
Into the lean and slipper
With spectacles on nose and pouch on side,
His youthful hose well sav'd, a world too wide
For his shrunk shank."*

—William Shakespeare, *As You Like It*, 2.7

Just as most men believe they possess a keen sense of humor, most men assume they are reasonably strong. Their muscle mass — the aggregate of muscle tissue they have built over a lifetime, enabling them to support their bones, fill the legs of their jeans, and lift the heavy end of a sofa — is at least adequate, relative to other men their age. Before my meeting with Gianni Maddalozzo, PhD, an exercise physiologist at Oregon State University, I was one of those men. After our meeting, I still think I have a pretty good sense of humor.

Maddalozzo's research focuses on the study of osteoporosis and muscle strength in adults ages 40 to 80. Most of his subjects suffer from advanced sarcopenia, the loss of muscle mass that occurs naturally — and inevitably — with age. Sarcopenia, in other words, is the scientific term for a phenomenon that Shakespeare identifies with the sixth age of man: the gray, traditionally enfeebled years of the "shrunk shank."

Compared with sarcopenia, other sneaky scourges of the middle years, such as arterial plaque buildup and prostate enlargement, announce their presence with a fanfare of symptoms. But sarcopenia creeps by in imperceptible increments, stealing a fifth of a pound of muscle a year, from ages 25 to 50, and then it picks up a dreadful, yet still mostly silent, velocity. The condition subsequently bleeds a man of up to a pound of muscle a year, a loss he is unlikely to notice until it's too late. "You haven't gotten any thinner, because the pounds of muscle are typically replaced by pounds of fat," explains Maddalozzo. "But sarcopenia is progressing all the time. One day you trip and fall and suffer a fracture of your hip. Then, when you try to rehab after hip-replacement surgery, you discover that you have virtually no muscle mass to build on."

While listening to the professor, I reflexively probe my thigh, sounding the depth and texture of my quadriceps muscle. By serving up a hypothetical untrained victim, I tell myself, Maddalozzo has provided a worst-case scenario. I, by contrast, have trained plenty in my lifetime: For the past 35 years, since my college football and lacrosse days, I may not have darkened a weight-room door, but I run 20 miles a week, and my body weight remains under control, as does my total cholesterol, blood pressure, and resting pulse rate. I had smugly assumed that my skinny butt was covered when it came to exercise. But now I know that I had only been drifting in a state of muscle-mass denial. These midlife realizations brought me to the Bone Research Lab at the university's campus in Corvallis, where Maddalozzo has offered to assess my state of muscular fitness and prescribe an anti-sarcopenia strength-training regimen.

Despite (or perhaps because of) its universal, inexorable nature, sarcopenia, until recently, did not get much respect. Indeed, until 1988, the condition lacked its own scientific name. "Historically, the scientific community has taken muscle for granted," concedes William Kraemer, PhD, a professor of kinesiology at the University of Connecticut. Perhaps more tellingly, sarcopenia's proven antidote — resistance training — will never make a dime for a pharmaceutical company. Scientists such as Kraemer, Maddalozzo, and a cadre of others are at the forefront of a movement that is redefining the importance of muscle mass in terms of overall health, not simply performance or vanity.

Recent research shows that diminished muscle strength and mass are empirically linked to declines in the immune system and the onset of heart disease and diabetes, not to mention weaker bones, stiffer joints, and slumping postures. Muscle mass has also been shown to play a central role in protein metabolism, which is particularly important in the response to stress, and decreased muscle mass correlates with a decline in overall metabolic rate (muscle mass burns more calories at rest than fat does). Further research is expected to show measureable links between diminished muscle mass and cancer mortality. The thinking about muscles and resistance training, in short, is reaching critical mass, and a major shift in the American fitness paradigm is under way. Along with this increasing emphasis on resistance training, there is an increasing awareness about the nutritional factors that can complement muscle growth, namely increasing daily intake of protein.

"In the last 20 years, we have come full circle," says Wojtek Chodzko-Zajko, PhD, a professor of kinesiology and community health at the University of Illinois and a fellow of the American College of Sports Medicine. "We used to discourage older adults from lifting heavy weights. Now we're telling them they can't maintain overall health without it. After age 50, you can't get by just doing aerobic exercise." Although it's not explicit yet in the government's overall health guidelines, agencies such as the Centers for Disease Control and Prevention now recommend a couple of rounds of resistance training a week. "Muscle function can improve — sometimes robustly — with resistance training, even after the onset of sarcopenia," says Robert Wolfe, PhD, a professor of geriatrics at the University of Arkansas. "But it is far more effective to begin resistance training before the process gains momentum. Intervention in the middle years is necessary."

The muscles of most men reach maximum size (or, strictly speaking, attain the maximum number of fibers per muscle) at age 25. From that lamentably early peak, a long, gradual decline ensues. Over the next 25 years, the muscles lose approximately 10 percent of their fibers. Then, starting around age 50, things go to hell. The body's production of testosterone, human growth hormone, and DHEA ebbs, and the motor cells of your nervous system, which spider out from the spinal cord to control the contraction of muscle fibers during physical activity, deteriorate rapidly. As the motor cells die, so do the fibers to which they're attached, especially type II or "fast-twitch" fibers, the ones employed for short bursts of anaerobic power. For instance, if your biceps consist of 90 fibers when you're 50 years old, by age 80,

that number will be closer to 50 fibers, most of them feeble type "slow-twitch" fibers.

It's through the study of sarcopenia that a greater appreciation of muscle mass is evolving. Two seminal works, "Starvation in Man," an article published in the *New England Journal of Medicine* in 1970, and *Hunger Disease: Studies by the Jewish Physicians in the Warsaw Ghetto*, a book published in 1979, show that the depletion of muscle mass is the cause of death in human starvation. This is because essential organs and tissues such as the brain, heart, and liver rely on a steady supply of amino acids to synthesize new proteins and maintain function. Normally, dietary protein supplies these amino acids. Under duress, however, these organs maintain homeostasis by drawing protein from the muscles. Our skeletal muscle mass, besides powering all of our movements, also serves as a reservoir for our vital organs. And like all reservoirs, this one can run low — or, in the case of starvation, run dry.

Less dramatic maladies also demonstrate a deep relationship with sarcopenia. "Not surprisingly," observes Wolfe, "individuals with limited reserves of muscle mass respond poorly to stress." A 2000 study in the *Annals of the New York Academy of Science* examining lung-cancer patients undergoing chemotherapy, for instance, showed that the recurrence of cancer was predicted by levels of body protein. In 2004, a study in the *Annals of Medicine* demonstrated a clear link between diminished muscle mass and cardiac failure. And a 2006 study in the *Journal of the American College of Surgeons* found that survival from severe burns was lowest among individuals with reduced muscle mass.

In 2005, results from the Mediterranean Intensive Oxidant Study, which examined the causes of osteoporosis in men, found that bone density and mineral content had a direct correlation to skeletal muscle mass. "The stronger and thicker your muscle tissue, the more force that tissue exerts on the bone," explains Maddalozzo. "And increased force, both during exercise and normal daily functioning, results in the bones growing stronger and denser. That significantly retards osteoporosis and, as a man ages, the rate of hip fractures." A man with a full reservoir of muscle mass enjoys dual protection: stronger bones combined with enhanced strength and agility.

Muscle mass has also proved to play a key role in more common, but no less deadly, conditions such as cardiovascular disease and diabetes. A study of scientific literature published in *Circulation* in 2006 cites articles showing that sarcopenia has been linked to insulin resistance (the main factor in adult-onset, or type 2, diabetes), elevated lipid levels in the blood, and increased body fat, especially "visceral adipose tissue," which gathers around the heart and other vital organs and is a primary risk factor of heart disease. In fact, researchers concluded that long-term adaptation to resistance training lowers cortisol response to acute stress; increases total energy expenditure; relieves anxiety, depression, and insomnia; and demonstrates beneficial effects on bone density, arthritis, hypertension, lipid profiles, and exercise tolerance in coronary artery disease. "As the dates on these studies indicate, we are just seeing the tip of the research iceberg," says Wolfe. "In the years ahead, we are likely to see the proof of even closer relationships between muscle mass and disease states."

The case against overreliance on cardiovascular fitness — a case striking close to my heart — was made best in a study conducted at East Tennessee State University more than a decade ago. Researchers studied 43 healthy individuals who were 55 or older. Twenty-three of the subjects worked out three times a week for 30 minutes per session, confining their exercise to the treadmill, stair machine, and stationary bike. The other 20 subjects performed 15 minutes of aerobic exercise and devoted the rest of their sessions to training their major muscle groups on weight machines. After four months, bone density and lean muscle mass increased significantly in the group combining aerobic and strength training, but it did not improve for the group confined to aerobic activity.

Maddalozzo and I leave the Bone Lab and stroll across campus. He nods hello to students, whose endocrine systems sluice with testosterone and growth hormone, the juices goosing youthful muscle development. From a modest distance, Maddalozzo, at age 52, might pass as one of them. He carries a well-toned 150 pounds on a 5-foot-9-inch frame, with just 10 percent body fat.

Despite the sunshine, the professor's hospitality, and the presence of so many attractive young people, my mood continues to darken. I experience a moment of classic middle-aged angst, as if I were approaching a sigmoidoscopy or a periodontal exam. I worry, in short, that I've seen the light too late. My "muscle intervention" threatens to be as penitential as it sounds. According to Wolfe, Kraemer, Chodzko-Zajko, and other experts, resistance training must be conducted at a high intensity, at 70 percent or more of the maximum perceived effort, in order to produce the cellular and metabolic changes that yield stronger, thicker muscles and the resultant health benefits. "A little bit of training — swinging a five-pound dumbbell around — just won't cut it," says Kraemer. "That's not enough to catalyze growth and engage the systems."

The premise of all strength training is the concept of overload and recovery. Muscle fibers are made up of long strands of protein, and overloading the muscles to the point of failure during weight training causes microtears in myofibrils, the tiny proteins that force the muscle cells to contract. This activates satellite cells located on the outside of the muscle fibers to accumulate at the point where the damage occurs (much in the way that white blood cells gather at the site of skin lacerations). In effect, resistance training triggers an alarm that the muscle is falling apart, and the substance the body uses to fix it — the glue, as it were — is protein.

That's why scientists such as Maddalozzo also emphasize a muscle-friendly diet that will complement — and, to a certain degree, compensate for — the bare-bones, let's-get-through-this strength-training programs that most people are likely to follow. "Unless you eat the right diet, you won't get the best benefit from strength training," says Fred Hahn, a trainer in New York City. "You absolutely must have an adequate intake of protein for your body to adapt to the stress." In Wolfe's 2006 study in the *American Journal of Clinical Nutrition*, "The Underappreciated Role of Muscle in Health and Disease," he argues that the present recommended daily allowance of protein, 0.36 grams per pound of body weight, was established using obsolete data and is woefully inadequate for an individual doing resistance training. He, along with many others, recommends an amount between 0.8 and 1 gram per pound of body weight.

Strength training conforms to all the puritanical dictates that I, along with countless other men my age, spent our youths repudiating: You have to keep track, you have to keep improving, and it hurts. The weight room occupies the

basement of a nearby classroom building. The room is clean and airy, with neat rows of machines and free weights, just a few small mirrors, and at this hour, to my relief, no students. Still, my heart sinks. I have never liked gyms of any description. They all seem like places of confinement, regimentation, and pain. Despite the dawning of a new age of muscle awareness, this still seems true.

To steel myself, I recall some of strength training's well-documented, no-nonsense health benefits: bone density... resting energy expenditure... protein metabolism... blood lipids. The promises we heard about running in the 1970s and '80s we now hear about weight training. In fact, some experts, such as Greg Anderson, an elite trainer in Seattle, maintain that weights and diet are all you need; you don't have to do traditional cardio at all.

Of course, I'm not the only former countercultural desperado who has to be dragged off the running trail and into the weight room. Recognizing that resistance training is less convenient and, by and large, requires more concentration than aerobic training (you can't linger over erotic fantasies as you do while laying down the miles at lunchtime under a canopy of Douglas fir), various researchers are trying to determine rock-bottom minimum workouts for muscle-mass maintenance.

Maddalozzo's strength-training program, which he teaches others and practices himself, is one of these new programs: It is two 30-minute sessions a week, comprising one set of eight full-body, multijoint exercises. Each exercise consists of eight to 15 reps, at 60 to 80 percent of "maximum perceived effort," with the final rep performed to the point of voluntary failure. "I work 60 hours a week, and I have two kids at home," says Maddalozzo. "I don't have the time or interest to spend hours in a gym."

"We'll start with the squat," he says, leading me across the floor to a bare barbell. "That's the fundamental lower-body exercise. You need basic leg strength for your running and also for general functioning, for movements such as getting in and out of a chair."

Getting in and out of a chair? "How much weight?" I ask coolly.

Maddalozzo hesitates. "Before we talk about weight," he says, "let's see a squat with no resistance." I reach for the barbell, but he stops me. "We don't even need that for now. Let's just see you do a squat."

I squat, or at least I give my version of a squat. I begin by pushing out my knees, and then I bend from the waist with my shoulders curled forward. "Not like that," says Maddalozzo. "You need to keep your back flat and your shoulders square, and drop your buttocks." He demonstrates the proper form with striking ease and fluidity.

I try to copy the motion, but I am dealing with decades of scar tissue from a torn ACL, compensating behavior, avoidance, and, I admit, increasingly active sarcopenia. My shanks have undeniably shrunk.

I try a third time, imagining myself as a baseball catcher crouching behind a batter.

Maddalozzo brightens. "Good," he says. "That's perfect."

It hardly feels perfect. Bands of pain shoot through the decimated muscle fibers of my tight, weak hamstrings. I force myself to squat lower, and in so doing, I briefly lose my balance. I touch the mat to right myself. My quads begin to tremble. A cool breeze combs the room, but I start to sweat. With some gruesome noises from my knee joint, and another bolt of pain, I stand, a lean and sneakered pantaloons, summoning as much dignity as possible.

"I guess I should begin with a pretty modest weight."

Maddalozzo gives an encouraging smile. "Just by repeating the proper motion a couple of times, you're starting to redirect your neural pathways," he says. "You're on your way. Let's go try some lunges."

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