Vanishing Flesh

Muscle loss in the elderly finally gets some respect

By JANET RALOFF

If you're 35 to 40, although you're feeling fit as ever, you have probably begun losing skeletal muscle, the tissue that provides your strength and mobility.

Slow, inexorable muscle wasting occurs even in healthy individuals who engage in regular aerobic exercise, but it usually goes unnoticed for decades. In fact, the body hides its loss by subtly padding affected areas with extra fat. So maintaining your weight perfectly over time does not mean muscle isn't vanishing, notes Steven B. Heymsfield of St. Luke's-Roosevelt Hospital Center in New York.

This phenomenon didn't even have a name 8 years ago. At that time, while speaking at a conference on aging, Irwin H. Rosenberg wondered aloud whether its anonymity accounted for the paucity of research on it—and for the medical community's apparent lack of concern over its role in crippling society's elders.

Several recent studies have indicated that while thinning bones render the elderly especially vulnerable to fractures, it's the unsteadiness caused by muscle wasting in the legs that leads to falls. To the extent that it makes walking, stair climbing, and getting in and out of chairs difficult, muscle loss can not only rob aging adults of their independence but also steer them into unhealthful, sedentary lifestyles.

"So that we could begin taking this problem seriously, I suggested, half tongue in cheek, that we give it a name—sarcopenia," recalls Rosenberg, director of the Agriculture Department's Jean Mayer Human Nutrition Research Center on Aging at Tufts University in Boston. He hoped the Greek moniker's classical ring would give it the cachet to catch on.

The tactic worked.

Sarcopenia, which means "vanishing flesh," has begun popping up in medical texts and gerontology papers. It even appears in a solicitation for new research proposals just issued by the National Institute on Aging (NIA) in Bethesda, Md. The institute convened a conference 4 weeks ago on techniques for studying sarcopenia, with the goal of spurring more research in the area. Next spring, NIA plans to launch an 8-year study of how this muscle loss affects activity and recovery from disease in 3,000 otherwise healthy septuagenarians.

At its annual meeting in October, the American Aging Association has scheduled a session on sarcopenia. And Miriam E. Nelson of the Tufts center has written a book for the general public, due out next year, describing exercises that her studies show can fight the ravages of muscle loss.

Grandmaster Tingsen Xu teaches Tai Chi Quan, a balance-enhancing exercise, to reduce frailty and improve balance. In one study that Xu and his colleagues at Emory University in Atlanta published earlier this year, 15 weeks of Tai Chi training in persons age 70 and over appeared to reduce by more than 47 percent their risk of falling more than once.

Sarcopenia is well on its way to becoming a household word, like osteoporosis, concludes geriatrician Tamara Harris of NIA.

Gilbert Forbes of the University of Rochester (N.Y.) School of Medicine holds the world's record for the longest chronicle of age-related muscle loss in a single individual. Since he was 44, Forbes has measured his own fat-free mass on at least 150 separate occasions spanning 37 years. He has another 27 years' worth of data on a colleague, begun when that man was 53.

Skeletal muscle comprises about half of a person's lean body weight. Because the weight of the two other major components—bone and viscera (organs)—does not drop much over time, Forbes' measurements offer an indirect gauge of vanishing muscle.

Those data, reported at the Experimental Biology '96 meeting in Washington, D.C., this past April, indicate that Forbes experienced a fairly constant 1 kilogram per decade loss of muscle, roughly twice the rate of his heavier, more muscular colleague.

To get a speedier estimate of sarcopenia within the general population, Ronenn Roubenoff and Joseph Kehayias of the Tufts center have just finished measuring skeletal muscle in Boston area adults. By comparing people of different ages but similar builds, they're looking to identify when muscle loss begins and how quickly it proceeds.

"The data we have clearly show a decline from the thirties onward," Roubenoff told SCIENCE NEWS. Though men tend to start with more muscle, they appear to lose about the same percentage as women over time. Despite large individual variability, he says, the trends indicate "that if you're a healthy elderly person in your seventies, you're down about 20 percent [in skeletal muscle] from where you were at age 25 or 30."

Moreover, there are some indications that sarcopenia's ravages accelerate with time. So far, these associations "are primarily anecdotal," Harris says. However, she adds, there haven't been many attempts to look into it.

Eric T. Poehlman of the Baltimore Veterans Affairs Medical Center and his colleagues are among the few who have tackled this question. They reported finding just such a trend in the Nov. 1, 1995 ANNALS OF INTERNAL MEDICINE.

For 6 years, they followed 35 healthy but sedentary women who were in their mid to late forties at the start of the study. The investigators monitored such factors as physical activity, calories burned during periods of rest, and where their bodies store fat. Over this period, half of the women entered menopause.

While all the volunteers maintained a fairly constant weight, those who became menopausal lost an average of 3 kg of lean tissue during the study, six times the loss seen in the women of the same age who did not enter menopause. The menopausal women also became less active over the course of the study, a factor that can itself spur muscle loss.

This study didn't continue long enough to establish whether the acceleration of sarcopenia at menopause represents a permanent change. But Poehlman says his data clearly indicate that menopause "throws you into a downward spiral of muscle loss and inactivity—two things you don't want to happen."

One hallmark of menopause is a drop in a woman's production of the sex hormone estrogen. Might such a change accelerate sarcopenia? "It's possible," says endocrinologist Clifford J. Rosen of the Maine Center for Osteoporosis Research and Education at

St. Joseph Hospital in Bangor.

Estrogen helps modulate the body's production of a hormone, insulinlike growth factor 1 (IGF-1), that is important for muscle growth and development, Rosen notes. Growth hormone controls concentrations of IGF-1 even more directly. Like estrogen, growth hormone declines dramatically with age in both men and women.

Rosen therefore suspects that age-related drops in growth hormone, estrogen, and other hormones may play a driving role in sarcopenia.

To test that idea, he's conducting a year-long trial with 200 frail men and women over the age of 65. Half receive daily supplements of growth hormone, the others a placebo. If the study shows that the treatment halts muscle loss or aids an individual's ability to regain muscle strength with exercise, it may hold out the prospect of hormone therapy, he says.

Charlotte A. Peterson of the McClellan Memorial Veterans Hospital in Little Rock, Ark., suspects that some share of sarcopenia may also trace to problems involving satellite cells, the body's poorly understood muscle repair crews. Her data indicate that here again, IGF may play a role.

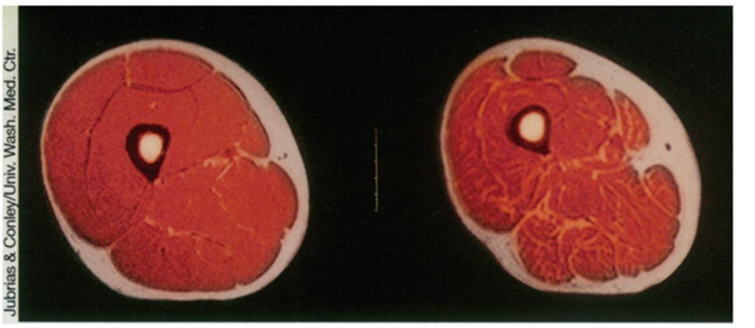
A large community of these satellite cells surrounds skeletal muscle. They do nothing until a muscle needs to grow or experiences damage—such as a bruise or those minor rips that cause aches the day after exercise. Then the satellite cells spring into action, migrating to where they're needed.

Some multiply and turn into new muscle, which eventually fuses to the old muscle. Others return to their quiet state to await the next crisis. "We're trying to figure out what signals which satellite cells to do what," Peterson explains.

What is clear, she says, is that the performance of satellite cells wanes with age. Her work with rats has shown that within just a few weeks, muscle damage in a 3- to 6-month-old young adult completely disappears. But when an elderly 24- to 28-month-old animal sustains the same damage, the satellite cells' repair proceeds much more slowly and often incompletely.

The real problem, she notes, may be not the satellite cells themselves but rather the body's difficulty in communicating with them. Other researchers have shown that when they transplant muscle and its satellite cells from an old animal into a young one, the muscle again heals rapidly.

Insulinlike growth factors "seem to be really important in controlling satellite cell function," Peterson says. Her preliminary evidence indicates "that satellite cells from older animals mount a less robust IGF response following injury." This suggests, she says, "that it's production of the growth factor that may be impaired."



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Magnetic resonance image of a thigh cross section from a 25-year-old man (left) and a 65-year-old man (right). Fat, in white, surrounds skeletal muscle, the reddish material encircling the bone. Though the thighs are of similar size, the older man's shows a growing buildup of fat around and through the muscle, indicating substantial muscle loss.

Age-related neurological changes may also play a pivotal role in sarcopenia.

Over decades, the body loses nerves, including those that branch out from the spinal cord into skeletal muscle throughout the body. As one of these nerves dies, a neighbor sends out branches to rescue the muscle fibers that had been abandoned. Without such a new nerve connection, that muscle would eventually shrink and die.

But there's a limit to how much a nerve can grow, according to studies by neurologist Jan Lexell of Lund University Hospital in Sweden. "It's somewhere around two to three times its original size," he says. "So it can double the number of muscle fibers that it innervates" but probably no more. When surviving nerves are no longer numerous enough to rescue all of the abandoned muscle fibers, he says, sarcopenia becomes inevitable.

Studies that have attempted to quantify the loss of these muscle-innervating nerves find that somewhere between one-quarter and one-half of them die off between the ages of 25 and 75. Moreover, Lexell observes, because the rate of nerve loss "speeds up after age 60," persons approaching 90 are likely to have suffered dramatically more loss.

His studies indicate that the first muscle fibers to go are those used the least—rapidly-contracting fibers that serve as a sort of muscular overdrive. The body calls on them to execute the most intense and rapid activities, such as heavy lifting and sprinting. The progressive loss of different types of muscle "accounts for part of the slowing of our movements with age," he says, and much of the frailty.

What all these studies confirm, Rosenberg maintains, is that although sarcopenia may represent a universal symptom of aging today, it should not be accepted as normal. Instead, he argues, it should be considered a newly recognized disease—amenable to prevention and treatment.

In fact, a series of studies at his center indicate that exercise regimes that focus on high-intensity resistance training of the arms and legs go a long way toward countering disabling frailty in the elderly. Lexell agrees, noting that this type of exercise wakes up languishing overdrive muscles by challenging them to gradually and steadily lift or move increasingly heavy weights.

"Older people who have done weight lifting over the last 15 to 20 years will have muscles the same size as someone who is 20 and sedentary," he notes.

It's never too late to start that muscle training, according to studies over the past few years led by Nelson and Maria A. Fiatarone of the Tufts center. In one 10-week study of 100 frail nursing home residents between the ages of 72 and 98 (SN: 6/25/94, p. 405), individuals more than doubled the strength of trained muscles and increased their stair-climbing power by 28 percent when they exercised their legs with resistance training three times a week.

Nelson's group then prescribed a less rigorous training regimen, with workouts only twice a week, in a year-long study with 50- to 70-year-old women. Not only did those who exercised increase their strength throughout the study, but they also gained skeletal muscle. Women who remained sedentary declined on both measures.

Moreover, this training offers payoffs that go well beyond sarcopenia, notes William J. Evans of Pennsylvania State University in University Park. A physiologist, he collaborated with the Tufts team on several of their exercise studies. While those women assigned to an exercise group in the year-long study gained a little bone over the course of their training, he notes that those who remained sedentary lost about 2 percent of their bone.

In another study, his group found that elderly men and women who performed strength training for 3 months burned 15 percent more calories over the course of a day than their sedentary counterparts. The difference was traced not so much to their increased exercise but to a boost in their metabolism, which should fight sluggishness and weight gain, he says.

In fact, he notes, those elderly adults who follow through on weight training tend to voluntarily increase their activity. In some cases, this training also enabled them to forsake wheelchairs for a walker or cane.

That's one reason the Tufts center is fighting sarcopenia so actively, Rosenberg says. Muscle loss is robbing the elderly of their freedom. "We want to give it back." □