

Science Reveals Why Exercise Takes Longer to Pay Off as You Get Older

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STORY AT-A-GLANCE

- › Sarcopenia, the age-related loss of muscle mass and strength, begins subtly in midlife and accelerates with age, increasing your risk of frailty, falls, and fractures
- › As your body ages, muscles become less responsive to training, and physical gains come more slowly, even when effort and consistency remain the same
- › A 2025 study published in Nature Communications found that older muscles fail to activate key growth pathways and repair signals after exercise, explaining the reduced adaptation
- › Despite slower gains, exercise remains essential not just for physical strength but also for brain function, heart health, immune regulation, and metabolic resilience across the aging process
- › Longevity benefits peak at around 40 to 60 minutes of strength training per week; exceeding this reverses the gains and increases the risk of overtraining

Staying active and following a regular workout routine offers clear physical and mental benefits at any age. But over time, progress slows. Movements demand more focus, recovery takes longer, and the gains that once came easily start to feel out of reach. Many people notice this shift as they get older, yet few understand why it happens.

To investigate what drives this transition, a research team from Korea examined how muscle tissue responds to resistance training in both younger and older individuals. Their work sheds light on the biological processes that shape adaptation and offers a deeper view into why the body handles the same physical demands differently over time.¹

The Muscle-Bone Breakdown – Why Strength Fades with Age

After the age of 60, you may notice tasks that once required little thought, such as lifting groceries, stepping over obstacles, and rising from a chair, begin to demand more conscious effort. This is not always linked to injury or disease. It often reflects a slow erosion in the tissue's capacity to grow and regenerate in response to regular use. Clinically, this slow decline in mass, strength, and function is known as sarcopenia.

- **Muscle and bone do not operate independently** – They are structurally and metabolically linked, and this relationship deepens with age. Muscles exert tension on bones, which helps maintain bone density through mechanical loading. When muscle mass decreases, the stimulus for bone preservation weakens. This contributes to the development of osteoporosis, a condition marked by porous, fragile bones that fracture more easily under pressure.²
- **Combined loss increases vulnerability to injury** – A stumble that might once have been absorbed by muscle control may lead to a fracture, and each fall carries a higher risk of long-term disability. The ability to live independently depends in part on the continued coordination of muscle strength and skeletal support.³
- **Anabolic resistance blunts the muscle-growth signal** – Anabolic resistance is one of the reasons muscle adapts more slowly with age. This refers to the reduced sensitivity of aging muscle fibers to signals that normally stimulate growth. Both protein intake and resistance training send anabolic cues, but older muscle cells are less responsive to them, making the muscle growth process take longer and require more strategic input.⁴

- **Muscle loss disrupts whole-body resilience** – The loss of muscle is not only visible in the mirror or on a scale. It also reshapes how energy is regulated, how glucose is cleared, how body temperature is maintained, and how the immune system responds to stress. Muscle is central to metabolic health, and its decline ripples across multiple systems that govern resilience, recovery, and lifespan.⁵

Understanding sarcopenia and its connection to bone loss brings attention to a part of aging that is often accepted without question. These changes may be considered common, but they are not trivial.

Why Muscles Adapt Less to Exercise as You Get Older

In the featured study published in the journal *Nature Communications*,⁶ researchers examined how aging affects the early molecular response to resistance training. By combining clinical data from human participants with mechanistic studies in mice, they mapped age-related shifts in muscle signaling, protein synthesis, and regeneration.

- **Muscle activation was tracked in both mice and men** – Muscle biopsies were collected from younger and older men before and after training their vastus lateralis, the largest and most powerful muscle in the quadriceps group.

In parallel, mice underwent muscle overload to assess conserved biological responses. This allowed researchers to directly compare age-related differences in response to exercise – meaning not just which genes got turned on, but which ones got converted into functional proteins.

- **Older adults showed a muted transcriptional response to exercise** – Resistance training in younger participants triggered strong upregulation of gene sets tied to protein synthesis, ribosome biogenesis (the process of building new ribosomes to support protein production), and cell growth. In older participants, these same pathways remained largely unresponsive, reflecting a breakdown in the muscle's anabolic initiation.

- **CLCF1 was identified as an essential age-sensitive cytokine** – The gene encoding cardiotrophin-like cytokine factor 1 (CLCF1) was strongly induced in young muscle after overload but not in aged muscle. When aged mice were treated with CLCF1, their muscle regained markers of growth and protein synthesis. These findings point to CLCF1 as a therapeutic target for reversing anabolic resistance.
- **CLCF1 also restored metabolic function in aged muscle** – Beyond growth signaling, CLCF1 enhanced insulin-independent glucose uptake in muscle cells, increased glycolysis, and upregulated mitochondrial respiration.

It activated the AKT/mTOR (for muscle growth and protein synthesis), STAT3 (energy metabolism and cell survival), and ERK1/2 (cell growth and repair) pathways, while suppressing catabolic FoxO signaling, which drives muscle breakdown. Together, these shifts improve both energy balance and protein building in aged tissue.

- **Bone strength improved through the muscle-bone axis** – CLCF1 treatment in old mice not only enhanced muscle function but also increased bone mass by suppressing osteoclast activity and modestly boosting osteoblast formation. Blocking CLCF1 erased the bone-building effects of exercise, revealing its essential role in musculoskeletal remodeling.
- **Age-related decline in CLCF1 secretion is linked to CRLF1 loss** – Although CLCF1 gene expression remains stable with age, its secretion depends on a protein called CRLF1, which declines significantly in aged muscle. This limits circulating CLCF1 levels and may explain why older individuals fail to mount a normal cytokine response to training. According to Dr. Yong Ryoul Yang, one of the study's lead authors:

“This research provides a biological basis for why exercise becomes less effective with age, and it lays the groundwork for developing new therapeutic strategies for healthy aging. In particular, the findings offer new directions for treating age-related sarcopenia and osteoporosis.”⁷

In short, aging doesn't prevent the body from performing exercise, but it does reduce how effectively muscle responds unless the underlying cellular changes are accounted for. Learn more about how resistance training supports healthy aging in ["It's Never Too Late to Begin Resistance Training."](#)

Why Exercise Should Be Part of a Healthy Aging Plan

Even as muscle adapts more slowly with age, the benefits of regular movement continue to reach far beyond strength alone. Exercise supports and protects multiple systems throughout the body, helping reinforce long-term resilience and vitality. It contributes to improvements in:

- **Brain health** — Regular movement improves cerebral blood flow and supports the release of growth factors that protect neurons and strengthen synaptic connections. These changes help preserve memory, concentration, and overall cognitive function. Over time, consistent physical activity has been linked to a lower risk of cognitive decline and better performance on tasks that require attention, decision-making, and recall.^{8,9}
- **Cardiovascular function** — As the cardiovascular system ages, staying active becomes one of the most reliable ways to protect its performance and responsiveness. It maintains the elasticity of blood vessels, lowers resting blood pressure, and improves heart rate variability. These adaptations help reduce the risk of stroke, heart attack, and heart failure, while improving stamina and circulatory efficiency.^{10,11}
- **Metabolic health** — Movement improves your body's ability to manage glucose and regulate insulin, helping stabilize blood sugar levels and prevent the metabolic shifts that often emerge with age. It also limits the accumulation of visceral fat, which plays a central role in driving inflammation and metabolic dysfunction. These benefits help reduce your risk of Type 2 diabetes, fatty liver disease, and weight gain associated with aging.^{12,13}

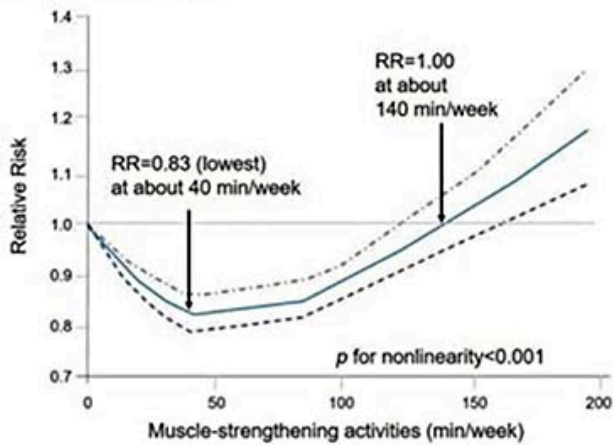
- **Immune resilience** – Regular training reduces markers of chronic inflammation and strengthens the regulation of immune responses. It enhances the efficiency of immune surveillance while lowering the likelihood of overactivation, which becomes more common as the immune system ages. These changes help protect against both infections and autoimmune complications.^{14,15}
- **Cellular repair and longevity** – At the cellular level, exercise activates pathways that promote mitochondrial function, oxidative balance, and internal cleanup through autophagy. These processes support tissue repair, energy metabolism, and resilience to stress. They form part of the biological foundation for slower aging and extended health span.^{16,17}

The Sweet Spot for Strength Training

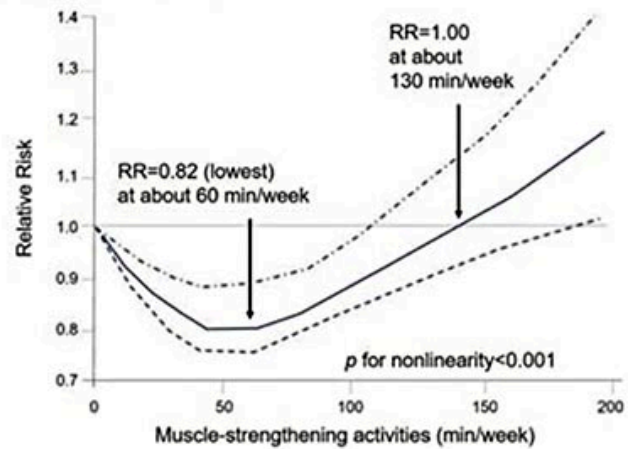
Doing more isn't always the answer, especially when your body's recovery capacity changes with age. While resistance training is an important tool for protecting muscle, bone, and brain health as we age, evidence suggests that overdoing it may actually shorten your lifespan.¹⁸

- **Longevity benefits peak at 40 to 60 minutes of lifting per week** – In my [interview with cardiologist James O'Keefe](#), he discussed findings from his research,¹⁹ wherein he observed that vigorous exercise backfires, especially when done in high volumes. As shown in the graph below, strength training has a J-shaped dose-response with all-cause mortality. Its benefits max out at around 40 to 60 minutes per week. Beyond that, the benefits plateau and eventually reverse.

All-cause Mortality (6 Studies)



All-cause Mortality (5 Studies)



- **How excessive exercise reduces your lifespan** – Prolonged intense physical activity places chronic stress on the body, leading to issues like cardiac overuse injury and an increased risk of musculoskeletal injuries. Overtraining also impairs recovery, causing fatigue, reduced performance, and a weakened immune system.
- **Training over two hours weekly negates the advantage** – When you're doing strength training for a total of 130 to 140 minutes per week, the longevity benefits of exercise go down to the point as if you're not exercising at all. In short, if you train for three to four hours a week, your long-term survival is worse than people who don't do strength training at all.
- **Excessive lifting leaves you worse off than being sedentary** – Again, when you're doing intense vigorous exercise in excess, you're still better off than people who are sedentary. But for some (yet undetermined) reason, excessive strength training leaves you worse off than being sedentary.
- **Aim for 20 minutes twice a week, not more** – The lesson here is to keep strength training to 20 minutes twice a week on non-consecutive days, or 40 minutes once a week. Moreover, it's just an add-on to your exercise regimen – don't center your entire exercise sessions around it. Moderate-intensity exercise such as walking gives you far greater benefits.

- **Even short weekly sessions protect against aging** – Interestingly, this moderate amount of strength training aligns with findings from the Brigham Young University study,²⁰ which showed that even small doses of resistance training – around 10 to 50 minutes weekly – result in measurable benefits to telomere length, slowing biological aging without the risks associated with overtraining.

To learn more about the benefits of weight training for older adults and how to incorporate it into your workout routine, read “[Strength Training Turns Back the Clock on Your Biological Age.](#)”

As you fine-tune your routine, having the right tools in place will help you stay consistent without going overboard. My Pax health platform is an essential tool that will help you monitor your training and recovery with greater precision.

Frequently Asked Questions (FAQs) About Exercise and Aging

Q: What is sarcopenia and how does it affect aging adults?

A: Sarcopenia is the age-related decline in muscle mass, strength, and function. It often begins subtly in midlife and accelerates with age, leading to reduced mobility, loss of balance, and a higher risk of falls and fractures.

Q: Why does it take longer to see results from exercise as you get older?

A: With age, muscle tissue becomes less responsive to growth signals triggered by strength training or protein intake, a phenomenon known as anabolic resistance. At the same time, the cellular machinery that supports repair and regeneration slows down, making physical gains take longer even with consistent effort.

Q: How is muscle loss connected to bone health and osteoporosis?

A: Muscle and bone are structurally and metabolically linked. When muscles contract, they apply tension to bones, helping maintain bone density through mechanical loading. As muscle mass declines, this stimulus weakens, increasing the risk of bone loss, fragility, and fractures.

Q: What's the ideal amount of strength training for longevity?

A: Studies suggest that 40 to 60 minutes of strength training per week provides the greatest longevity benefit. Training beyond that threshold may increase the risk of overuse injuries, reduce recovery, and diminish long-term health outcomes.

Q: Does exercise still benefit aging adults if muscle growth slows down?

A: Yes. Even if muscle growth takes longer, regular exercise supports brain function, cardiovascular performance, glucose regulation, immune resilience, and cellular repair. These benefits play a central role in healthy aging and help preserve independence.

Sources and References

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