Exercise Might Reverse Muscle Aging, New Research Suggests. 3 Exercises to Try

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New research suggests that exercise influences a cellular signaling pathway that helps clear out damaged muscle proteins.

We all know exercise is the best strategy for protecting muscles from age-related decline. After age 30, inactive adults can lose **3% to 5% of their muscle mass per decade**, and the pace picks up after 60. Fibrous tissue and fat gradually work their way into what remains, stiffening the muscle over time.

Now, **early research** published in the P*roceedings of the National Academy of Sciences*, might help explain how exercise benefits aging muscles. **Researchers at Duke-NUS Medical School** in Singapore found that exercise influences a key biological pathway that helps muscle cells repair and clear out damaged proteins that could otherwise weaken them.

â??We believe that this pathway represents a highly promising therapeutic target for combating age-related muscle wasting, termed as sarcopenia,â?• says Hong-Wen Tang, PhD, senior author of the study and an assistant professor in the Cancer and Stem Cell Biology Programme at Duke-NUS Medical School.

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What the research says:

The **new study in *PNAS*** from Duke-NUS Medical School found that as muscle ages, a protein called DEAF1 climbs and jams the cellâ??s growth switch on. That leaves no room for cleanup, so damaged proteins accumulate and muscle weakens. Exercise flips the switch back. It wakes up a set of longevity-linked proteins and the cellâ??s cleanup crew gets back to work. The study helps explain how both strength and endurance training protect aging muscle.

What this means for you:

1. **Lift something, at least twice a week.** Train all major muscle groups on two or more days, per the **2026 ACSM resistance training guidelines**, its first update in 17 years. Bands and bodyweight count. If youâ??re already losing strength, add balance work: a **network meta-analysis of 42 trials** found resistance plus balance training was the top combination for walking speed and getting out of a chair.
2. **Get your heart rate up, your way.** Steady cardio, intervals, and sprints all raised muscle mitochondrial content by 23% to 27% in a **review of nearly 6,000 people**, and age didnâ??t blunt the response. Short on time? Adults in their 80s improved muscle protein synthesis with **three 16.5-minute bike sessions a week** for four weeks.
3. **Consider blood flow restriction if heavy lifting isnâ??t an option.** Light loads with a cuff beat the same light loads without one in a **meta-analysis of 14 trials in adults over 60**. Heavy lifting still won, so treat BFR as a bridge, and check with your doctor first.

Keep reading for how the FOXO-DEAF1-mTORC1 axis works, what senior author Hong-Wen Tang, PhD, told us about why aging muscle is uniquely vulnerable, and the full breakdown of each training approach.

Clearing Cellular Waste for Muscle Health

This study focused on fruit flies and mice. More research is of course needed to figure out how this might work in people, though **human trials** have already linked exercise to changes in mTOR signaling.

In this research, aged mice ran on treadmills and on resistance wheels, adding to the evidence that both endurance and strength work help you maintain healthy muscle, by building it up and by slowing muscle aging.

â??As we age, our muscle cells slowly lose their ability to self-repair because a transcription factor called DEAF1 becomes abnormally over-expressed,â?• says Tang. â??This accumulation pushes a growth-regulating protein complex, known as mTORC1, into chronic overdrive.â?•

Muscle proteins are constantly building and breaking down. A little boost of mTORC1 isnâ??t always a bad thing. However, long-term elevations in mTORC1 activity can inhibit the natural cellular cleanup processes that remove damaged muscle proteins.

â??Over time, this imbalance traps cellular garbage inside the cells, causing muscle wasting and weakness,â?• explains Tang.

In older animals, raising DEAF1 levels made muscles weaker. Aged fruit flies with elevated DEAF1 struggled to climb the side of a vial, a standard measure of muscle function. Younger flies were unaffected, which suggests itâ??s aging muscle specifically that becomes vulnerable to this shift.

Hereâ??s where exercise comes in. Researchers found that in the lab animals, exercise ramped up a family of molecular switches â?? FOXO â?? that suppressed DEAF1, normalizing mTORC1 activity to help preserve muscle function. **FOXO activity** in muscles tends to decline with age, reducing control over DEAF1 and mTORC1.

â??Regular physical activity fundamentally resets this broken system,â?• said Tang.

Hereâ??s why: Physical activity places a healthy mechanical and metabolic stress on skeletal muscles, triggering intracellular signaling cascades that act like alarms to activate and mobilize FOXO proteins. Those FOXO proteins then bind to the gene responsible for DEAF1, acting as a powerful molecular brake to slow it down. As a result, mTORC1 activity returns to normal.

â??With the self-cleaning machinery restored, aging muscles can efficiently clear out accumulated cellular debris, repair structural damage, and maintain functional strength, effectively keeping muscles stronger for longer,â?• says Tang.

The Three Exercise Strategies That Target Age-Related Muscle Loss

This study focused on fruit flies and mice. More research is of course needed to figure out how this might work in people, though there are certainly **human studies** connecting exercise to altered mTOR signaling.

We may not know exactly which exercises best target the FOXO-DEAF1-mTORC1 axis, but we do have clues. This research, which exposed animals to both aerobic and strength training, adds to the evidence suggesting that both help you maintain healthy muscles both by building them up and slowing muscle aging.

â??Our findings suggest that both aerobic (endurance) exercise and resistance (strength) training are beneficial for muscle health,â?• notes Tang. â??Each type of exercise activates the bodyâ??s protective FOXO pathway in slightly different ways, and doing a combination of both is likely to provide the greatest benefit.â?•

Three ways to start turning back the clock on muscle aging:

1. 1 **Strength training:** Lifting weights is a classic for a reason. A **network meta-analysis**

of 42 randomized trials in nearly 3,800 older adults with sarcopenia found that resistance exercise improved physical function, and that adding balance training to resistance work was the most effective combination of all for gait speed and for getting out of a chair. For ideas on structuring the resistance half, the American College of Sports Medicine released its **2026 resistance training guidelines** in March, its first update in 17 years.

2. 2 **Aerobic training:** Whether you prefer long, winding runs or short sprints, aerobic exercise can help rejuvenate your muscles. A **systematic review** pooling data from nearly 6,000 people found that continuous endurance training, high-intensity interval training, and sprint interval training all increased muscle mitochondrial content by 23% to 27%. The researchers also found that the capacity to adapt to training holds up across the lifespan, regardless of age, sex, or disease. That matters, since muscle mitochondria, the cellular powerhouses that produce energy to power muscle movement, tend to decline with aging, contributing to size and strength losses.

   And itâ??s never too late to start. In a **study of adults in their 80s** who were living with conditions like hypertension and osteoarthritis, interval training improved muscle protein synthesis and mitochondrial capacity, possibly by acting on a different cellular signaling pathway, the phosphoinositide 3-kinase-Akt-mTOR route that helps stimulate muscle growth. Participants completed three 16.5-minute sessions per week for four weeks. Each session opened with a 2-minute warmup of unloaded cycling, then five 1-minute efforts on a stationary bike at 100% to 115% of their maximum load, each followed by 90 seconds of unloaded pedaling. A 2-minute cooldown closed it out. No adverse events were reported.

3. 3 **Blood flow restriction (BFR) training:** Consider adding a new accessory to your workout. In a **2022 review**, researchers proposed that BFR, which uses a cuff to reduce blood flow in target muscles during aerobic or resistance exercise, could help counter age-related muscle loss through its effects on blood vessels, hormones, tissue oxygen levels, muscle fiber recruitment, and muscle stem cells.

A **meta-analysis of 14 trials** in healthy adults over 60 found that low-load BFR training, at 20% to 40% of 1-rep max, produced better strength gains than the same light loads without the cuff. Heavy lifting still outperformed both, so BFR is best understood as a bridge rather than a replacement. BFR appears to be safe for many people, but always check with your doctor before trying it and consider working with a trainer or other professional who can help you do it safely. Need somewhere to start? Try **Arthur Brooksâ?? BFR workout**.

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