

Why does it take longer to recover from exercise as you age?

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This article looks into recovery from exercise (which is key to getting enough training volume/cycle in to generate the improvements you are after) and what the latest research has to say about this topic.

Quantitative loss of muscle mass, referred to as "sarcopenia", is the most important fitness factor underlying aging ([See my article on Sarcopenia](#)). However, qualitative changes of muscle fibres and tendons, such as selective atrophy of fast-twitch fibres and reduced tendon stiffness, and neural changes, such as lower activation of the agonist muscles and higher coactivation of the antagonist muscles, also account for the age-related decline in muscle function.

RECOVERY IS SLOWER IN AGED ATHLETES

There is impairment in the recovery processes with aging. Research has shown lower Muscle Protein Synthesis rates in well-trained masters triathletes over 3 d of training compared to their younger competitors, and this likely contributes to poorer muscle protein repair and remodeling.

There has been shown to be functional decreases in energy supply replenishment both before and after exercise. Phosphocreatine recovery rate was initially lower in the older than in the young participants. the recovery rate of oxygenated hemoglobin was reduced in the older compared with the young group, suggesting an impaired oxygen supply to the muscles of the older participants.

These investigations have found evidence of differences between young and aging participants for acute recovery of physiological parameters from fatiguing exercise, suggesting that for a similar exercise stimulus, a longer recovery period might be required before older adults return to baseline levels.

The two logical arguments for delayed recovery in older athletes are that aging leads to a greater amount of exercise-induced damage or fatigue and that there is an impaired rate of repair or adaptation after an exercise bout (Figure 1).

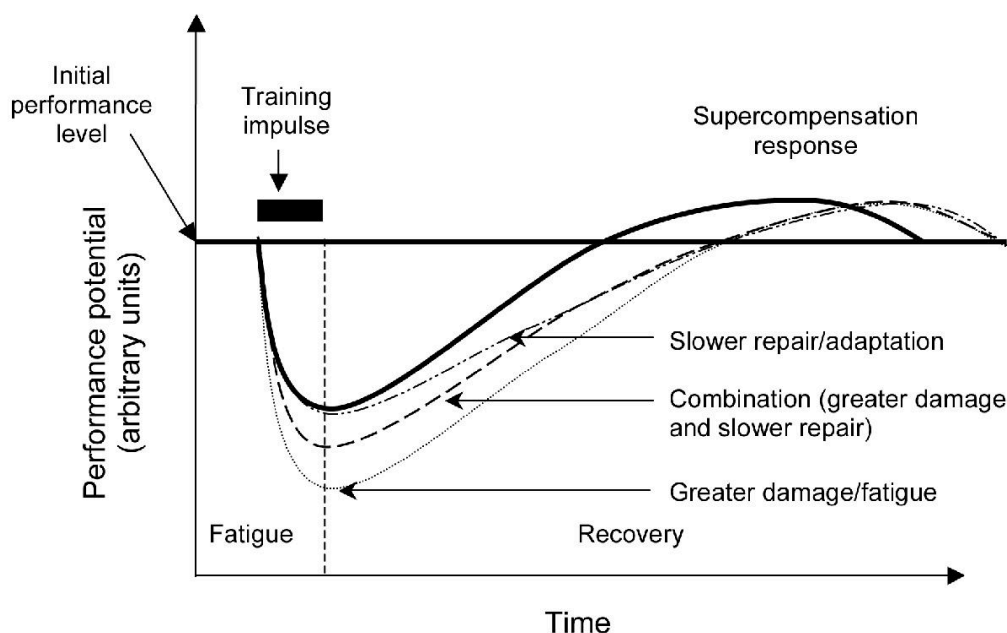


Figure 1 — Theoretical model of the time course of adaptation after an exercise impulse. Bold line denotes normal model, and dashed lines represent proposed models for an aging athlete experiencing greater damage or slowed recovery (adapted from Smith & Norris, 2002).

Contrary to this view, Roth et al. (1999) reported that the amount of muscle damage was no different for younger (20–30 years) and older men (65–75 years) indicating that the recovery repair process slows down with aging. Whereas 65- to 75-year-old women exhibited higher levels of muscle damage than 20- to 30-year-old women (Roth et al., 2000) this latter result suggested a potential role of estrogen in protecting against muscle damage.

If the skeletal muscle of both young and aging athletes experiences similar amounts of exercise-induced damage but the kinetics of recovery are slowed with age, the time period before full performance recovery after exercise would be extended as we age.

Differences in the recovery kinetics of young and aging muscle can be investigated by comparing variables such as the time taken to replenish energy substrates or to repair structural and functional changes induced by exercise.

Exercise-induced muscle damage has been shown to impair post-exercise muscle glycogen resynthesis .

Any impairment of glucose transport and glycogenesis post-exercise could contribute to delayed recovery and decreased subsequent exercise capacity if the exercise is performed before complete recovery of glycogen stores .

TRAINING INCREASES RESILIENCE TO AGING.

Musculoskeletal-Tissue Recovery and Repair. The concern for aging athletes is that the time taken for muscle to repair and recover after fatiguing exercise or exercise-induced damage might be longer than for young muscle, slowing and potentially limiting the adaptation response (Figures 2).

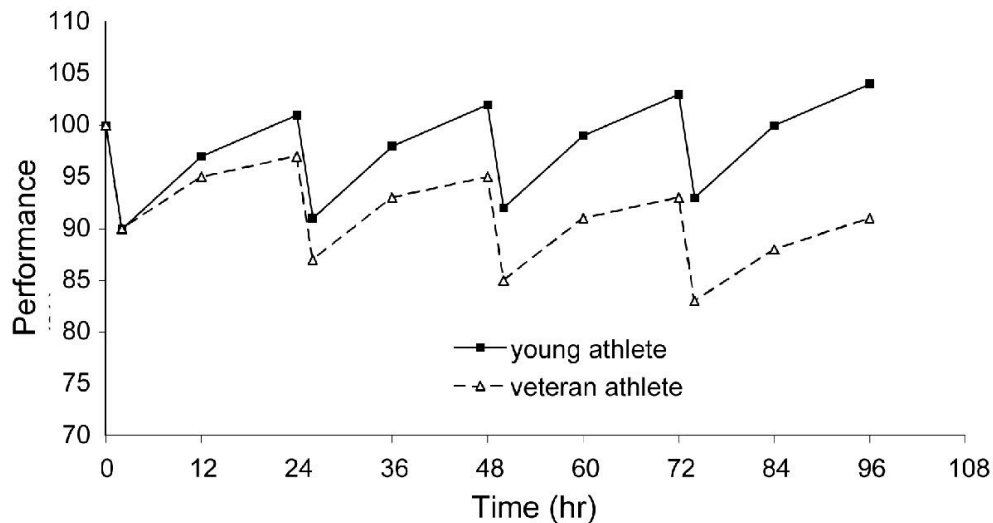


Figure 2 — Hypothetical training response in young and veteran athletes demonstrating the progressive overreaching response in the veteran athlete because of an impaired rate of recovery from fatigue after training sessions.

Although the training model aims to elicit progressive overload leading to positive functional adaptations and improved performance, the concern for older athletes is that if recovery processes are impaired there is a greater risk of inadequate recovery, whereby continued training actually results in progressive overreaching. Progressive overreaching involves a gradual decline in functional performance despite maintenance of training load, because of insufficient recovery (Figure 2).

A recent study by Pimental et al. (2003) found that there was no notable decline in training volume, cardiovascular fitness, or athletic performance up to 50 years of age in well-trained runners. Beyond the age of 50, however, all these variables begin to decline rapidly. What cannot be ascertained from this research is whether the decrements in performance and cardiovascular fitness are caused by declines in training volume or vice versa. This raises the question as to whether older athletes voluntarily reduce their training volume because of age-related declines in rate of recovery, or, alternatively, when they attempt to maintain training volumes, their athletic performance declines because of inadequate recovery (progressive overreaching).

MUSCLE ADAPTATION

There might be critical ages to which muscle function can be maintained if undertaking appropriate training protocols but beyond which rapid decrements in function are unavoidable. Whilst it has been shown that repeated exercise bouts may provide a level of protection for aging muscle, the adaptation might be slower in the older muscle.

This finding suggests that older muscle might experience slower but equivalent adaptation to exercise compared with young muscle and also provides evidence for the hypothesized prolonged recovery duration in older athletes because of slower adaptation mechanisms.

CARDIOVASCULAR/BIOCHEMICAL RECOVERY IN AGED ATHLETES

Following exercise, RER values (respiratory Exchange Ratio) recovered more quickly among young men than among aged men. This was the first indication of age-specific recovery patterns following exercise of moderate intensity and duration.

Maximum HRM's are lower in aged men. In the important cardiovascular measure of relative HR, it was again during recovery, not exercise, that age-related differences were manifested. That is, recovery was more effective in young men, as they experienced a significant decrease in relative HR from the 5th to the 15th minute of recovery. Aged men showed no change during this interval. As further evidence of the greater challenge of post-exercise recovery encountered by aged persons, relative HR was higher among the aged men than among the young men at both the 5th and 15th minute of recovery.

Age-related differences in temperature were most apparent following, not during, exercise. Whereas young men showed successive, if not statistically significant, decrements in temperature throughout the post-exercise period, aged men experienced continual increases in temperature during the recovery phase.

The impaired thermoregulation of aged participants following exercise may be related to body composition. Aged men were found to have significantly more body fat than were young men (27% vs 17%), and the insulating effect of subcutaneous fat impairs the body's ability to dissipate heat . Thus, increased body fat probably accounted for the thermoregulatory difficulties demonstrated by aged men following exercise .

The young group's lactate concentrations continually decreased from the 15th minute of exercise such that, by the end of the recovery period, this marker of muscular stress was no longer elevated from pre-exercise levels. In contrast, lactate remained significantly increased throughout the 15-minute recovery period in aged men. And as with lactate, age-related differences in plasma glucose responses were most notable during recovery, not during exercise. Unlike those of younger men, glucose concentrations of older participants were significantly higher during recovery than they were prior to the onset of exercise.

All told, the data presented here indicates that it is not during exercise that most age-related differences are evident, but rather during post-exercise recovery. Every physiological system examined revealed that the homeostatic mechanisms used during recovery in attempting to counter exercise-induced adjustments were less effective among aged men than among young ones.

Additional research highlighted that recovery is slower in the aged athlete where damaging eccentric contractions are involved, whereas there are no age-related differences in recovery from less damaging metabolic fatigue .

Also muscle function as assessed by reaction time and movement time after damaging exercise was not affected in either the older or young participants, suggesting that skill-related aspects of neuromuscular function might not be affected by age or muscle damage.

Recovery of maximal contraction force after fatiguing, but not damaging, exercise might be well preserved with age.

These research results are important as they show that if as an older athlete you can train with minimal muscle damage, recovery rates can be as good as that of a much younger athlete.

PAIN TOLERANCE & RECOVERY RATES IN AGING

The common perception of a delayed recovery with ageing was supported by the longer reported duration required to recover between intense training and competition in athletes 30 years and older. This slower recovery does not appear to be due to major dietary differences between young and veteran athletes. In contrast to the perception of slower recovery repeated days of intense endurance cycling exercise was similarly tolerated by young and veteran athletes with respect to performance. However, there is a greater change in the perception of, muscle soreness and significant changes in fatigue and recovery in veteran athletes.

Exercise with Eccentric loads increased recovery time with older athletes.

Exercise with minimal eccentric loading, no difference b/w young and old.

Greater perception of fatigue/pain from older group.

TRAINING INCREASES RESILIENCE TO AGING

Physiological data from elite and non-elite, recreational, sedentary, and senior athletes clearly indicate that human skeletal muscle has a high degree of plasticity that is maintained late into life. Muscle fiber protein expression and single muscle fiber contractile properties are greatly influenced by exercise training. It appears that skeletal muscle can quickly adapt to accommodate a wide range of functionality to meet the demands (or lack of demands) placed upon it.

In muscle biopsies from septuagenarians with a history of lifelong high-level recreational activity the mechanical and biochemical changes suggest that lifelong high-level exercise allows the body to adapt to the consequences of the age-related denervation of skeletal muscle (and associated reduction in motor unit functionality) and that it preserves muscle structure and function by saving otherwise lost muscle fibers through recruitment to different slow motor units.

TRAINING INTENSITY MAINTAINED WITH AGING

Knee extensor muscle strength and metabolism were examined in endurance trained young versus master athletes (10 elderly: 62.5 $\pm$ 4.1 yr and 10 young: 26.2 $\pm$ 2.4 yr). Results suggested that the ability of master athletes to perform exercise at a given intensity is maintained despite a significant loss in strength with ageing.

VO₂ KINETICS CAN BE MAINTAINED THROUGH TRAINING IN THE AGING

The behaviour of VO₂ following the onset of exercise, including the rate at which it rises, is known as 'VO₂ kinetics'.

This study showed that the slower VO₂ kinetics typically observed in older individuals can be prevented by long-term endurance training interventions. Although the role of O₂ delivery relative to peripheral use cannot be elucidated from the current measures, the absence of age-related slowing of VO₂ kinetics seems to be partly related to a preservation of the matching of O₂ delivery to O₂ utilization in chronically trained older individuals.

CELLULAR IMPROVEMENTS THROUGH TRAINING IN THE AGED

Exercise might cause a preconditioning effect in aging muscle that could attenuate subsequent exercise-induced damage because of the regeneration of muscle fibers that occurs after the exercise stimulus.

Appropriate regular exercise training in aging organisms can prevent cellular damage caused by oxidative stress

Glycogen Recovery. Although there is evidence that aging muscle might have lower resting levels of both high energy phosphates and glycogen, it is likely that in humans this is largely the result of a more sedentary lifestyle, because training has been shown to restore resting levels toward that of young muscle .

Key points include:

- 1) aging per se is not the primary culprit leading to cellular (mitochondrial dysfunction);
- 2) an aerobic exercise program, even at an older age, can ameliorate the loss in skeletal muscle mitochondrial content and may prevent aging muscle degeneration; and
- 3) the improvement of mitochondrial function is all about **CONTENT** (meaning how often you stress the system eg – through exercise).

Exercise might cause a preconditioning effect in aging muscle that could attenuate subsequent exercise-induced damage because of the regeneration of muscle fibers that occurs after the exercise stimulus.

Appropriate regular exercise training in aging organisms can prevent cellular damage caused by oxidative stress

SUMMARY

This above research highlights that training intensities b/w young and aging athletes can be similar but that the aging athlete must increase their recovery periods to compensate for the reduction in muscle recovery mechanisms that occur due to the onset of aging.

As a personal example, my training partner and I (both in our 50's) have had to reduce the total times per week that we can perform certain lifts (down to 3-times per fortnight for heavy compound lifts (eg deadlifts) – BUT our intensity is as high as it has been in the past and we are continually improving each cycle without having to deal with overtraining or overreaching from trying to achieve 3-sessions/week.

Final words – Once you are over ~50-years of age – **INJURY FREE TRAINING TIME** is the NO. 1 objective that you should be striving for. Recovery from injury is much slower as you age and this will have a very negative effect upon you achieving your performance goals.

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