

Aerobic Decline & Aging

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This is the last of my Exercise Physiology blog articles on aging – I wanted to cover off the major physiological changes we can expect as we age as well as highlight where we can reduce these physiological losses and even regain some youthfulness in some aspects.

My next series of blog articles will outline a range of practical steps on how we can best go about either getting fit (fitter!) or maintaining our fitness into old age.

If you are like me, I am in denial as to my physiological decline and I am doing everything I can to stave off the effects of aging for as long as I can.

Physiology behind Aerobic decline.

The **Anatomical Aerobic Decline** mechanisms we experience with aging include :

1. The heart becomes slightly hypertrophic (enlarged) and hyporesponsive (less response) to sympathetic (flight or fight) but not parasympathetic (rest and digest), so that the exercise-induced increases in heart rate and myocardial contractility are blunted in older hearts.
2. The aorta and major elastic arteries become elongated and stiffer, with increased pulse wave velocity (rate at which the blood pressure pulse propagates through the circulatory system) which is a measure of arterial stiffness which increases the load on the CV system.

3. The arterial baroreflex is sizably altered in aging (Baroflex is the most important mechanism for moment-to-moment control of arterial blood pressure) with a definite impairment of arterial baroreceptor control of the heart but much better preserved baroreceptor control of peripheral vascular resistance.

These vascular changes then cause the following **Physiological Aging Decline** in outputs during maximal exercise:

1. Lower Stroke Volume (volume of blood pumped from the left ventricle per beat).
2. Lower Maximum Heart Rate.
3. The above two changes result in a lower Cardiac output (the volume of blood being pumped by the heart per unit time) which in turn results in;
4. A lowering of VO₂ Max (losses as much as 10% per decade from 50 years onwards. (trained individuals may lose less but still ~6-7% per decade).
5. Women have larger losses of the above physiological factors due mainly to higher body fat percentages.

What is trainable (Maintainable/Reversible)?

The good news:

Aerobic exercise can reverse age-related peripheral circulatory changes in older healthy males (35-50 years).

This research highlighted that the age-related decline in maximal oxygen consumption results from a reversible deconditioning effect on the distribution of cardiac output to exercising muscle and an age-related reduction in cardiac output reserve.

Specifics of this research found:

- As expected, cardiac output and AV (Arteriovenous) oxygen difference during exercise were significantly lower in older subjects.
- With training, both aged and young subjects increased maximal oxygen consumption by 17.8% and 20.2%, respectively.
- Systemic AV oxygen difference increased 14.4% in the older group and 14.3% in the younger group and accounted for the changes experienced in peak oxygen consumption. Peak leg blood flow increased by 50% in older subjects, whereas the younger group showed no significant change.

A study on post menopausal women highlighted that older women athletes who had habitually performed vigorous endurance exercise training had higher stroke volumes and cardiac outputs than sedentary postmenopausal women during maximal exercise.

The less than good news:

Age-related loss of VO₂ max seems to occur in a non-linear fashion in association with declines in physical activity. In sedentary individuals, this non-linear decline generally occurs during the twenties and thirties whereas athletic individuals demonstrate a non-linear decline upon

decreasing or ceasing training (typically 50's & 60's).

Current evidence supports a ~10% per decade decline in VO_2 max in men and women regardless of activity level. High-intensity exercise may reduce this loss by up to 50% in young and middle-aged men, but this is a much lower percentage in older men.

VO_2 max values in trained individuals decrease slower to around 60 years of age then accelerates regardless of the level/intensity of training undertaken.

One view for this sudden decline is that above 60 years it becomes increasingly difficult to sustain high intensity exercise and as such decreases in all cardiovascular outputs occur.

Non-linear loss rates are also demonstrated in individuals over the age of 70 years. The decline in VO_2 max seems to be due to both central and peripheral adaptations, primarily reductions in maximal heart rate (HR max) and lean body mass (LBM). Exercise training does not influence declines in HR max.

SUMMARY

1. It is accepted that whilst there will be decrements in physiological outputs as we age, (aerobic capacity included), there is some scope to slow down and even partly reverse some of this decrement depending on the physical attribute, age and training background of the individual.
2. What we can surmise from the research is that with the appropriate training we can keep the aerobic decrement largely at bay until we reach our 50's.
3. If we are going to lose around 10% VO_2 max per year, then the higher our starting point at the time in our life we start losing this attribute the better off we will be as we age.
4. If we continue to train as intensely as we possibly can (remember that training intensity can be maintained, it is just training volume that needs to be decreased), we maximise our chance of holding onto as much cardiovascular fitness as long into old age as we can.

For more information on aerobic training for the older trainer - check out my previous blog ([Introduction to running for the older adult](#))

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