# Masters Athletes

## INTRODUCTION

## PHYSIOLOGY AND PERFORMANCE

### PHYSIOLOGY

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- Pulmonary Adaptations

### PERFORMANCE

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- Cycling
- Weightlifting
- Baseball

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### Objectives

- List the adaptations that occur in the musculoskeletal, cardiovascular, and pulmonary systems that occur in the masters athlete.
- Briefly describe the changes in strength, power, and endurance performances observed with advancing age.
- List the recommendations in carbohydrate, fat, protein, water, and nutrient intake for ageing athletes.
- How well do older adults adapt to training? What characterises training in masters athletes?
- Why are masters athletes more prone to injuries? What steps can be taken to avoid injuries? What are the keys to rehabilitation?
**Introduction**

Physical ability can be maintained at remarkable levels for a very long time!

- John Kelley, at age 83, ran his 60th Boston Marathon in 1991
- Hellen Zechmeister world deadlift record in female 75-79 with 220.5 lb.

The masters athlete is a key factor in advancing our understanding of the role of physical activity in modifying the impact of ageing.

**Physiology and Performance**

As increasing numbers of older individuals continue to compete in athletics, we are becoming aware of extraordinary performances in ageing adults. Nonetheless, a number of changes in physiological parameters and a certain decline in performance is observed.

**Physiology**

**Musculoskeletal Adaptations**

Muscular strength is maintained until age 60, and then strength levels fall rapidly independent of training. The decreased strength is due to atrophy of muscle fibres. Testosterone and growth hormone both have an increased decline after age 60.

With ageing and master's athletes specifically there is an increase in slow twitch fibres as fast twitch fibres are lost and replaced by slow twitch fibres. However, this increase is not as much as their sedentary counterparts. Training duration and intensity seem to play a role in fibre-type distribution.

There is little change in skeletal muscle oxidative capacity with age, as long as training is maintained. The number of capillaries per unit area of muscle is the same in young and old endurance athletes.

**Cardiovascular Adaptations**

An unavoidable consequence of ageing is a decline in the maximal capacity of the cardiovascular system to pump blood and deliver oxygen to the muscle. Stroke volume is well maintained in middle-aged and master athletes who continue to train intensely. Maximal heart rate decreases with age, but an intense training program seems to slow down the loss. Peripheral resistance increases with age, resulting in a decrease in maximal blood flow to the working muscles. Age matched controls demonstrate a greater increase in peripheral resistance compared to masters athletes; however, older athletes do still demonstrate higher systolic blood pressure and greater ventricular wall thickness than younger athletes.
Paffenberger found that repeated bursts of high-energy outputs established a plateau of protection against coronary mortality. The vigorous activity helps to protect the ageing heart against ischemia and its consequences. The incidence of cardiac arrest is decreased for masters athletes.

**Pulmonary Adaptations**

There is a gradual structural loss within the lung that supports the alveoli, small airways and blood vessels. There is a gradual loss of the muscular strength of the respiratory system. Master's Athletes who train for competition long distance running have a VO$_2$ max of 50% more than their sedentary counterparts do. Reduction for masters athletes is 5% per decade over the course of a lifetime in comparison to their sedentary counterparts of 9% per decade. Masters athletes on average have a 15% lower VO$_2$ max than younger athletes.

**Performance**

**Track and Field**

**Running**

In distance events, we observe a gradual loss, not accelerated until past age 80. The performance, 10K - 40 min for men; 1 hour for women – is better than the average younger individual.
In the mile, we observe a gradual loss until past age 85. And even then eight minute miles are observed – times similar to sedentary 30 – 40.

Figure 1: Masters world record for males and females in the (a) 100-m, (b) 800-m, and (c) 10K races. Data from Masters Age Records for 1990
<table>
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<td>90</td>
<td>13:42.60</td>
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</table>

**Table 1**: Miles run times. Data from Masters Age Records for 1990 (1991).

In numerous physiological parameters, there is about a 1% percent loss per year (like HRmax, VO2max). Masters athletes are able to maintain 50% of their ability until age 80 to 84.

**Figure 2**: Percent of the world record achieved by masters competitors at various ages. Data from Masters Age Records for 1990 (1991).
Throwing
A decline of 2% per year can be seen due to changes in power; neuromuscular ability, muscle, etc.

Jumping
Jumping performance is more affected than running, even sprinting (lower leg power and complex whole-body coordination) (triple jump: anaerobic energy, timing, spatial perception, flexibility, balance, withstanding jarring force - most influenced by ageing - 56 - 63 % decline).

Figure 3: Difference in age-related changes for five running distance when data are collected cross-sectionally vs. longitudinally. Data from Stories and Kozma (1982a, p. 187)

Figure 4: Masters world records for males and females in the (a) discus throw and (b) shot put. The arrow in (b) emphasizes that females age 35 to 49 use a 4-kg shot, and beginning at age 50 they use a 3-kg shot. Data from Masters Age Records for 1990 (1990).
Figure 5 Masters world records for male and female jumping: (a) high jump, (b) long jump, and (c) triple jump. Data from Masters Age Records for 1990 (1990).
Figure 6: 100m sprint times vs. age

Figure 7: Canadian 1500m records with age
Swimming

Figure 8 Percent of the world record achieved by male record holders of different ages. In the case of the 10K distance, the world-record holder was 35 years old, thus his score was 100% of the world record. The record for the 80 to 84 year old age category was 60% of the world record. Data from Masters Age Records for 1990 (1990).

Decline Longitudinal 5-year data also available - age-related declines substantially less.
Figure 9  Swimming speed as a function of cohort age and distance for (a) females (b) males. Data are from a repeated cross-sectional activity. From "Performance Changes in Champion Swimmers Aged 30 to 84 years" by A.A. Hartley and J.T. Hartley, 1984, Experimental Ageing Research, 10, 146. Copyright 1984 by Beech Hill Enterprises, Inc. Reprinted by permission.
Cycling

During time trials, it was observed that men 60 - 69 lost 17% in 40 km time trial vs. 22% in 10 K run.

Figure 10: Records from the 1990 United States Cycling Federation 40K Road Race Trials: (a) absolute time in minutes; (b) percent of U.S. record for each age group. Data from the United States Cycling Federation (1990).
Weightlifting

It has been observed that:

- By age 70-74 only 40% of the record
- Peak power for snatch and clean and jerk - more loss with age
- And cumulative effects of age on strength, coordination, flexibility, agility, balance - poorer performances in weight lifting than in the "power lifting" events

**Figure 11:** Masters national records for the clean-and-jerk. (a) Weight lifted for light - (56 and 60 kg classes), middle - (75, 82.5, and 90 kg classes), and heavyweights (100 and 110 kg classes); (b) percent of the world record for each weight class. The decline with age can be described extremely well by a linear equation (r=0.988). Data from the United States Weightlifting Federation (1991).
Figure 12: Masters national records for the dead lift. (a) Weight lifted; (b) percent of world record for each weight class. (Data from the United States Powerlifting Federation (1991).
Baseball

From the data of 10 year careers of 5 hall of famers, the following has been noted:

- Hitting power and accuracy peaked at age 27 then declined and done at age 33.

Figure 13: Comparison of masters national records for a lift that is purely strength (dead lift) and a lift that requires power, coordination, flexibility, and balance (clean and jerk): (a) lightweights, (b) middleweights, and (c) heavyweights. Data from the United States Weightlifting Federation (1991) and the United States Powerlifting Federation (1991).
Nutrition
The key is: A WELL BALANCED DIET

"The general principles of optimal nutrition for a masters athlete are much the same as for a younger competitor." (Shephard, 1995) ... Unfortunately, even with exercise and regular training, a decrease in metabolic rate and a reduced calorie intake will occur; therefore, the nutritional quality of the foods the athlete is consuming becomes increasingly important as the athlete ages.

General Principles
- Dietary goals and nutrition advice must first guide the individual toward meeting basic nutrient need.
- Proper diet (i.e. nutrient intake according to the recommendations) in conjunction with exercise decrease the risk of chronic disease (CAD, cancer).
- Certain aspects of nutrition and diet may affect athletic performance (this is as important to the older competitor as it is to a younger elite athlete). This includes pre-event meals, carbohydrate loading and nutritional supplements.

Caloric Expenditure
As recommended by Dr. Cheryl Rock, RD (1991)

Regular exercise increases TOTAL DAILY CALORIC EXPENDITURE. Energy requirements may need to be increased for older athletes that are underweight or "normal weight" in order to maintain health and continue exercise activities.

Carbohydrates
Carbohydrates may need to comprise a higher percentage of total energy in the diet (especially for prolonged endurance activities) in order to maximize performance.

Carbohydrate Loading
Results in enhanced glycogen stores, but is only advantageous for specific (high intensity, endurance) and prolonged (2-4 hours) exercise. Has also been known to cause the following adverse effects: chest pains, ECG abnormalities, water retention, and muscle damage (Hopkins & Thompson, 1988)

Carbohydrate Replacement
Energy drinks are a source of significant caloric contribution and although may help replace glycogen stores, may be detrimental for those athletes aiming for weight control (Rock, 1991).
**Protein**

Protein requirements also may increase due to increased gluconeogenesis, increased muscle breakdown, increased amino acid oxidation, and depression of protein synthesis. For adults of all ages RDA for protein is 0.8g/kg/day. According to Sacheck and Roubenoff (1999), older athletes should strive to consume between 0.8-1.0/kg/day. Increased requirements occur with high intensity exercise and increased protein utilization with longer-duration activity. Increased need with a decrease in energy intake.

**Fats**

Elderly individuals maintain the ability to digest and absorb fat well. Fat is a major fuel source at 60-70% of maximal work capacity, and increased utilization of fats occurs with training and prolonged exercise ... BUT, carbohydrate remains the most important fuel source. Optimally, fat should be maintained at 25-30% of total calories to reduce the risk of CVD and stroke.

**Water**

Changes occur with ageing that contribute to difficulty in maintaining fluid volume. As protein stores decrease with age, so does total body water. In addition, renal antidiuretic hormone (ADH) receptors lose efficiency, there is a decreased thirst sensation due to a decrease in osmoreceptor sensitivity, a decreased number of sweat glands, and a reduced blood flow to skin. DUE TO THESE CHANGES THAT OCCUR WITH AGE, THE OLDER ATHLETE MUST BE CONSCIENTIOUS ABOUT FLUID INTAKE DURING EXERCISE!

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Changes with ageing and exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riboflavin</td>
<td>Increase requirement with training and increased caloric consumption</td>
</tr>
<tr>
<td>Vitamin B6</td>
<td>Increase intake</td>
</tr>
<tr>
<td>Vitamin B12</td>
<td>Increase intake (necessary to prevent anemia)</td>
</tr>
<tr>
<td>Folate</td>
<td>Increase intake</td>
</tr>
<tr>
<td>Calcium</td>
<td>Increase requirement due to sweat loss, and may decrease risk of fracture</td>
</tr>
<tr>
<td>Iron</td>
<td>Increase intake (only necessary if the elderly athlete is a vegetarian or participating in long-distance running)</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>Increase intake? (questionable antioxidant effects)</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Increase if deficiency is present</td>
</tr>
</tbody>
</table>

**Training**

- Train for fun and enjoyment
- Personal pace and effort are to be emphasized
- Train for the love of the sport
- Ensure amount of training is sufficient to maintain an active lifestyle
- The decline in top performance in older athletes would seem to be age-related, something which cannot be overridden or compensated for by training
- Losses with ageing can be remarkably reduced with lifelong program of intense training
- Endurance training produces similar gains in healthy people regardless of their age, gender, initial level of fitness
• Ability to adapt to training reduced for those who are inactive
• Older individuals are not able to improve strength and endurance capacities to match abilities of the young
• The older the athlete, the less likely they are to warm up before training or competition
• Older athletes train with less intensity

Injuries
• Masters athletes are more prone to injury because they have stiffer tendons, muscles, and joint capsules, brittle ligaments, a reduced rate of tissue repair, decreased joint flexibility and loss of bone mass.
• The incidence of overuse injuries are more prevalent than acute injuries in older athletes. Osteoarthritis is the greatest threat to ageing athletes and is characterized by inflammation of the joints between the bones, usually as a result of excess wear and tear. The older athlete's body takes longer to heal, but the quality of the repair is comparable to that of a young athlete.
• Long time exerciser have a good understanding of rehabilitation and their compliance with a rehabilitation program is generally excellent. Immobilization should be the last resort after a sports injury; aggressive physical therapy ensures complete recovery and sport modification prevent a loss in physical conditioning.
• A sufficient warm up, good flexibility, and resistance training are all good injury preventative steps.