

PART 5

*Special Topics Within Exercise Physiology*

Chapter 16

**Growth, Development, Aging and Exercise**

**Exercise and Children**

Children are not small adults in how they respond to exercise. Nevertheless, many of the physiological responses to exercise are similar between children and adults.

Research tells us:

- ♥ Too many children do not engage in enough *vigorous* physical activity
- ♥ Participation in physical activity declines as age increases during school years
- ♥ Daily *enrolment in physical education* classes dropped from 42 to 25% among high school students between 1991 - 1995
- ♥ Children need help to develop appropriate exercise habits

**Health and Fitness of Children**

Beginning in the 1950's and early 1960's, several organizations began surveying youth fitness in the United States.

AAHPER

Institute For Aerobics Research  
Government of Canada

**Criterion referenced fitness standards** - a minimal level score for selected fitness variables that meet acceptable standards for good health.

Table 17.1: Description of different youth fitness tests, simplified

<i>Fitness Component</i>	<i>AAHPER 1958</i>	<i>AAHPER 1975</i>	<i>AAHPER 1988</i>
<i>Cardiorespiratory endurance</i>	600-vd (550-m) walk/run	600-vd (550-m) walk/run	1-mile (1.6-km) run/walk
<i>Body composition</i>	None	None	Skinfolds sum
<i>Flexibility</i>	None	None	Sit-and-reach
<i>Abdominal muscular Strength &amp; endurance</i>	Sit-ups (straight leg)	Sit-ups (bent knee)	Sit-ups (crunches)
<i>Upper body muscular Strength &amp; endurance</i>	Pull-ups	Pull-ups (boys) Flexed armhane (girls)	Pull-ups

Table 17.1: Description of different youth fitness tests, cont 'd

<i>Fitness Component</i>	<i>AAHPER 1958</i>	<i>AAHPER 1975</i>	<i>AAHPER 1988</i>
<i>Anaerobic power</i>	Standing long jump	Standing long jump	None
<i>Speed</i>	50-vd (45.0-m) dash	50-vd (45.0-m) dash	None
<i>Agility</i>	Shuttle run	Shuttle run	None
<i>Motor Skill</i>	Softball throw	None	None

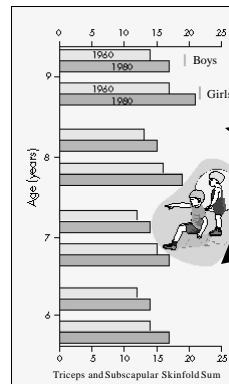
## Body Fat

From 1960's - 1980's there has been an increase in skinfold thickness in children aged 6-11.

Obesity incidence in this population has increased from 17.6% to 27.1% in this time period.

Causes for the increased fat content of children are

- ☹ - Physical activity
- ☹ - Television viewing



Note the trend from 1960 to 1980 for both boys and girls

## Strength

American children have poor muscular strength, especially for the upper body.

*Problem: relationship between muscular strength and endurance to scores on the flexed arm hang and pull-up are not well validated*

Based on 1985 testing:

- ☹ **40% of boys** aged 6-12 could not complete more than 1 pull-up
- ☹ **70% of girls** aged 6-12 could not complete more than 1 pull-up
- ☹ **45% of boys** and **55% of girls** aged 6-14 could not hold their chins over a raised bar for more than 10s

## Aerobic Capacity

Performance in the 1mile run field test has declined from 1980 to 1985 by approximately 10%. In addition, American children score worse than children from Europe, Great Britain, Australia and Canada.

### Coronary Artery Disease

- ~ **40%** of children ages 5-8 show at least 1 risk factor for heart disease  
(high cholesterol, physical inactivity, obesity, hypertension)

*Coronary artery disease is now recognized as a pediatric disease*

*Some reasons for the concern over the cardiovascular health of our children are:*

- ☹ CHD takes over 20 yrs to develop
- ☹ Children are *more fat* and *less fit* than 20 years ago
- ☹ 30-35% of school-aged children are at risk for CHD
- ☹ 50% of children are overweight
- ☹ 42% of children have high blood cholesterol
- ☹ 28% of children have high blood pressure
- ☹ The average 2-5 year-old watches 22 hr of television/week. 6-11 year olds watch 20 hr/week
- ☹ 11 million children in the US are considered obese

## Growth and Development

Children do not grow at a uniform rate throughout the course of their development.

The most rapid increase in height and weight occurs during **puberty**, and is referred to as the **pubertal growth spurt**

The most rapid rate of growth occurs during the adolescent years, and is referred to as the **peak height velocity (PHV)**.

Girls tend to be slightly taller and heavier than boys from years 2-10, and PHV occurs 2 years earlier in girls than boys

### Training Considerations

Even when controlling for maturation, it is clear that children can adapt to endurance training

Physiologic changes in children resulting from training and growth and maturation

Characteristic	Change
Heart rate, resting and submaximal	Decrease
Arterial blood pressure, maximal	Increase
Minute ventilation, maximal	Increase
Oxygen uptake, maximal (L/min)	Increase
Blood and muscle lactate, maximal	Increase
Muscular strength	Increase
Anaerobic power (Watts/kg)	Increase

### Thermoregulation

Children are not as effective in dissipating heat as adults:

- produce more heat relative to body mass
- lower sweat rates at rest and during exercise
- greater energy expenditure during exercise
- lower cardiac output relative to metabolic intensity
- rely more on convective heat loss than evaporative cooling

### Defining Aging

A manifestation of biological events that occur over time.

The **natural lifespan** is suggested to be the age of 85.

Life expectancy is the average, statistically predicted length of life for an individual.

- 71 years for men of developed countries
- 78 years for women of developed countries

*It is estimated that in the near future 50% of all deaths will occur after the age of 80 years*

Unfortunately, a large percentage of today's elderly live their last years of life in ill health. Thus, they do not have a *healthy life* that spans as much of their life span as could be possible.

The quality of life is also important. This is best reflected in the ability of an individual to perform activities of daily living (ADL's)

Longevity refers to the duration of life, and is dependent on:

- Heredity
- Environmental factors
- Good medical and health services
- Individual hygiene and health habits

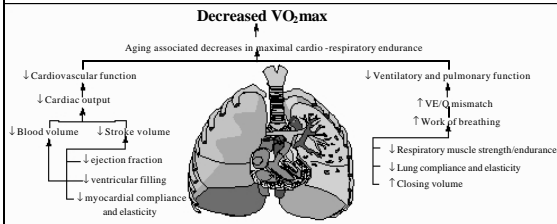
### Effects of exercise and age on select body systems, simplified

Body System	Exercise	Aging
<b>Circulatory</b>		
VO <sub>2</sub> max	Increase	Decrease
HRmax	Increase	Decrease
Cardiac Output, maximal	Increase	Decrease
Vascular resistance	Decrease	Increase
Blood pressure	Same or Decrease	Increase
<b>Blood Components</b>		
Total cholesterol	?	Increase
Triglycerides	Decrease	Increase
LDL cholesterol	?	Increase ?
HDL cholesterol	Increase	Decrease ?

### Effects of exercise and age on select body systems, cont'd

Body System	Exercise	Aging
<b>Musculoskeletal</b>		
Muscular strength	Increase	Decrease
Muscular endurance	Increase	Unchanged
Flexibility	Increase	Decrease
Bone mineral	Increase	Decrease
Lean body mass	Increase	Decrease
Adipose tissue	Decrease	Increase
<b>Regulatory systems</b>		
Basal metabolic rate	Increase	Decrease
Sleep	Increase ?	Decrease
Anxiety/Depression	Decrease?	Increase ?
Cognitive functioning	Increase	Decrease ?

## Maximal Oxygen Uptake ( $VO_2\max$ )

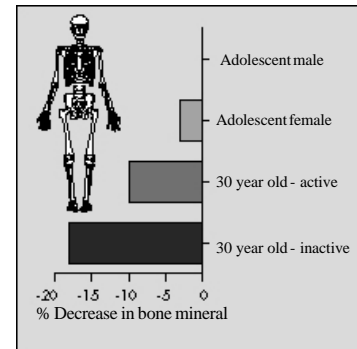


- ↗  $VO_2\max$  decreases 8-10%/decade after age 30
- ↗  $VO_2\max$  can be equally improved with training in the elderly as it is in youth

## Musculoskeletal System

By age 90, 32% of women and 17% of men will have sustained a hip fracture.

Regular physical activity can decrease the rate of age-related bone mineral loss



### Muscular Strength

Declines after ~ age 40, with an accelerated decline after age 60.

As with  $VO_2\max$ , strength training can increase muscular strength similar to that in youth

### Arthritis

Osteoarthritis - degenerative joint disease, caused by the wearing away of cartilage.

Rheumatoid arthritis - inflammation of the membrane surrounding joints.

*Exercise (eg. swimming) is beneficial to the individual with arthritis because it relieves pain and joint stiffness*