Exercise Concerns in Children

- **Exercise Testing**
- **Exercise Prescription**
- **Congenital Heart Diseases**

Exercise Tests in Children

- **Fitness Tests**
  - commonly used in school-based physical education
  - field test batteries
    - **Fitnessgram**
    - **President's Challenge test**
- **Clinical Tests**
  - known or suspected abnormalities
  - symptoms associated with exercise
  - measure functional capacity

Field Fitness Tests (table 11-1)

Aerobic Capacity	**1-mile walk/run**
Strength/endurance	**curl-ups pull-ups/push up**
Flexibility	**Sit-reach**
Agility	**Shuttle run**
Body composition	**BMI/SKF**

TABLE 11-2. Protocols Suitable for Graded Exercise Testing of Children*

Modified Balke Treadmill Protocol

Subject	Speed (mph)	Initial Grade (%)	Increment (%)	Stage Duration (min)
Poorly fit	3.00	6	2	2
Sedentary	3.25	6	2	2
Active	5.00	0	2.5	2
Athlete	5.25	0	2.5	2

The McMaster Cycle Test

Height (cm)	Initial Load (watts)	Increments (watts)	Step Duration (min)
<120	12.5	12.5	2
120–139.9	12.5	25	2
140–159.9	25	25	2
≥160	25	50 (boys) 25 (girls)	2

*Adapted from Skinner J. Exercise Testing and Exercise Prescription for Special Cases. 2nd ed. Philadelphia: Lea & Febiger, 1993.

Stress Testing in Children

- **Most children will not give a maximal effort, crying may be the end-point**
  - most children are sprinters not runners
- **Treadmill testing usually is preferred over cycle**
  - less leg fatigue, less need for cooperation
- **Results often are related to size, rather than age**

12 Year-Olds

Special Precautions

- **children are more prone to overuse injuries or damage to bone epiphyseal plates if excessive strain is applied**
  - Vary sports participation?
- **children are more prone to environmental temperatures**
  - smaller surface area/mass ratio
  - smaller absolute blood volume

Aerobic Prescription for kids, ACSM

- **Optimum amount and type is not defined**
  - individualized based in maturity, skill, medical status
  - > 6 yrs, > 30 min moderate intensity, each day
  - older children, 20-30 min vigorous ex, 3-5 d

AHA Physical Activity Standards for Children

- **Walking, bicycling, backyard play; use of stairs, playgrounds, and gymnasiums; interaction with other children**
- **Less than 2hr/d TV and video games**
- **Weekly, organized sports, lessons, etc**
- **Daily, 20 min organized school exercises**
- **Regular participation in household chores**
- **Weekly active family outings**
- **Positive role models (parents, teachers)**

Resistance Exercise Prescription in Kids?

- **Children can participate in properly designed and supervised REX program**
  - proper instruction in techniques is essential
  - slow controlled movements, no ballistic
  - avoid power lifting and body building goals
  - full ROM, multi-joint exercises

REX Prescription for Kids

- **avoid maximal weights (8 or more reps/set) not to maximal exertion**
- **1-2 sets of 8-10 exercises**
- **rest 1-2 min between exercises**
- **twice per week**

Congenital Heart Diseases

- **Atrial and ventricular septal defects**
- **Patent Ductus Arteriosus**
- **Coarctation of the Aorta**
- **Tetralogy of Fallot**
- **Uncommon**
  - atrioventricular septal defect
  - transposition of the great arteries
  - single ventricle (Fontan operation)
  - congenital coronary artery abnormalities

Heart Diseases: in general

- **Most are recognized in the first few yrs**
- **Outcome is usually better if repaired early--before long-lasting effects**
- **Often there are residual effects after surgery**
- **But, patients usually can participate in sports after repair**
  - depends on age and residual effects

Causes of Heart Defects

- **Hereditary factor (1-2%)**
- **Injury to the fetus**
  - vitamin deficiency, defective maternal metabolism, poor diet, drug effect, drugs and alcohol
- **Diseases during pregnancy**
  - German measles, rubella

Congenital Heart Disease

- **Occurs in 0.8% of all live births**
- **Most common kind of congenital defect**
- **98% of the time, diagnosed by 4 ys of age**
  - well-publicized exceptions
- **children are usually at low risk for sudden death during exercise**
  - side effects haven't developed yet

Atrial and Ventricular Septal Defects

- **Atrial (5-10% of congenital heart disease)**
- **Ventricular (15-20%)**
- **Hole between the left and right chambers**
  - left to right shunt
  - pulmonary hypertension
  - atrial and ventricular hypertrophy

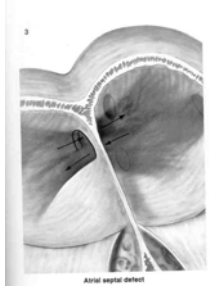
Atrial Septal Defect

- **Evander Holyfield, boxer of the decade, 1990-2000**
- **small atrial septal defect was found while training**

Septal Defects

- **Symptoms**
  - fatigue, increased respiratory illnesses, shortness of breathe, pulmonary hypertension
  - murmur, splitting of the second heart sound
  - arrhythmias, atrial & ventricular hypertrophy
  - limited exercise capacity

Atrial defect



Foramen ovale

A-V Septal Defects

- **Treatments**
  - closure during childhood
  - open heart surgery or transcatheter repair
- **Residual effects**
  - arrhythmias, RBBB
  - sinus node dysfunction
- **80% normal exercise tolerance after repair**

A-V Septal Defects

- **Exercise Guidelines**
  - small defect w/o pulmonary hypertension
    - **participate in all sports**
  - mild pulmonary hypertension
    - **low intensity sports only**
  - markedly elevated right heart pressures
    - **should not participate in competitive sports**

Patent Ductus Arteriosus

- **DA is a normal connection between the pulmonary artery and the aorta in the fetus**
  - closes within hrs of birth due to increased oxygen
- **5-10% of congenital heart disease—hole remains open**

Patent DA, symptoms

- **In adult, patent DA allows blood to flow from aorta to pulmonary artery**
  - increases lung bf
  - left ventricle must work extra hard
- **Increased bf in lungs**
- **left atrial and left ventricular dilation**
- **pulmonary vascular disease (high pressures)**
- **murmur**

Patent DA, exercise effects

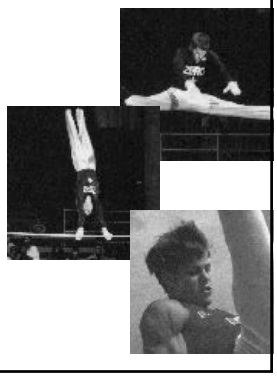
- **Small DA**
  - participate in all sports
- **Moderate or large DA with ventricular enlargement and severe pulmonary hypertension**
  - Must close DA
  - restricted from all sports until 3 months after repair

Coarctation of the Aorta

- **8-10% of congenital heart disease**
- **narrowing of the aorta**
- **elevated blood pressures in the upper body**
- **lower blood pressures in the lower body**
- **reduced development of the lower limbs**

Coarctation of the Aorta

- **Chris Waller**
- **1992 Men's National Gymnastic champion**
- **successful coarctation repair**
- **shortened lower body segment is an advantage in some sports**



Coarctation, symptoms

- **Murmur**
- **cold feet, leg cramps, nosebleeds, headaches**
- **much higher blood pressures/pulse in upper body than lower body**
- **hypertension**
- **dilated ascending aorta**
- **reduced exercise capacity, increased SBP**

Coarctation, exercise effects

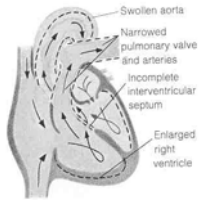
- **Pressure gradient between upper and lower body < 20 mmHg, normal resting bp, peak exercise SBP < 230 mmHg**
  - all but static sports, no power-lifting
- **Pressure grad > 20 mmHg, hypertension, peak exercise SBP > 230 mmHg**
  - low intensity exercise only

Tetralogy of Fallot

Blue Baby Syndrome

- **6% of congential heart disease**
- **4 characteristics**
  - pulmonary artery stenosis
  - right ventricular hypertrophy
  - ventricular septal defect
  - Enlarged aorta

Tetralogy of Fallot's four defects blight the heart. Oxygen-poor blood, blue-hued skin and ultimately death result. A "blue baby," bottom, recovers from life-saving surgery, a remedy available only since 1944.



Tetrology, symptoms

- **Cyanotic cardiac disease**
- **hypoxic spells, relieved by squatting-**
  - increase pressure in the left ventricle, closing the septal shunt so venous blood won't bypass the lungs
  - murmur and right ventricular hypertrophy
- **impaired exercise responses**

Tetrology, repair

- **Surgical closure of the shunt and opening of the pulmonary outflow tract**
- **80-85% will have a normal exercise capacity**
- **73% will have ventricular arrhythmias**
- **34% supraventricular tachycardia**

Tetrology, exercise effects

- **Normal or near-normal right-sided heart pressures, no residual shunt, no arrhythmias**
  - all competitive sports
- **Marked pulmonary regurgitation, elevated right ventricular pressure, arrhythmias**
  - low physical activity only
  - restrict static exercises

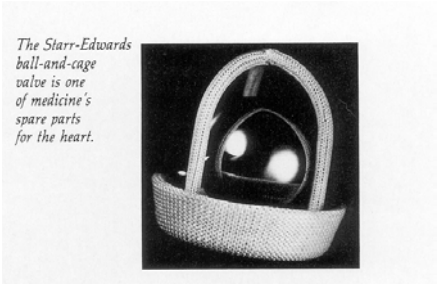
Congenital Valve Diseases

- **Pulmonary valve stenosis, 8-12 % of congenital heart disease**
- **Aortic valve stenosis, 3-6 %**
- **Increased pressures in right or left ventricles, respectively**
- **Decreased exercise capacity**
- **Risk of sudden death**

Valve Repair

- **Balloon valvuplasty**
- **Homograft**
  - pulmonary valve moved to aortic valve
  - "homograft" valve put in pulmonary position
- **Prosthetic valves**
- **Advantages of homograft**
  - valve grows with child
  - avoidance of anticoagulants

Prosthetic Valve



Valve replacement, exercise effects

- **Usually some remaining regurgitation**
- **New valve is weaker and prone to stenosis and blood clotting**
- **Subject may be on anti-coagulant therapy**
  - care with high static sports
  - care with contact sports

Conclusions:

- **Children after the age of 6 have similar exercise guidelines as adults, except**
  - limit maximal aerobic or resistive exercise
  - special precaution in hot or cold weather
- **Children with heart diseases**
  - usually are diagnosed before they begin sports
  - may be diagnosed from an unusual exercise response
  - have minimal long-lasting effects when diagnosed early