Section III: Concept 11: Muscular Fitness

Physical activity pyramid

- Rest or inactivity
- Exercise for flexibility
- Exercise for strength & muscular endurance
- Aerobic activity
- Active sport
- Lifetime physical activity

DO EXERCISE
Health Benefits of Muscular Fitness

- Include muscular strength and endurance
- Promote many health benefits
  - Avoiding back problems
  - Reducing risks of injury
  - Reducing risks of osteoporosis
  - Maintain BMR and promote long term weight control
Other Benefits of Muscular Fitness

- Look good
- Feel good
  - Muscular fitness can promote self esteem
- Improve performing daily life activities, especially elderly
Muscular Strength and Endurance

Definition

Although muscular strength and endurance are interrelated, they differ in the following ways:

– Strength is defined as the ability to exert maximum force against resistance.

– One-Repetition Maximum (1-RM)—The maximal weight an individual can lift just once.
Muscular Strength and Endurance

- Endurance is the ability to exert submaximal force repeatedly over time.
  - Muscular endurance depends on muscular strength and to a much lesser extent on CV endurance.
  - Is increased through gains in muscular strength. muscle metabolic and circulatory function
- The maximum number of repetitions can be performed at a given percentage (e.g. 70%) of 1-RM.
Relative Strength

- The amount of weight lifted relative to the person's body weight
- Measured as a ratio:

Relative Strength = \frac{\text{weight lifted (lb.)}}{\text{body weight (lb.)}}
Question: Who’s stronger:
- A: 250 pound person who can lift 200 pounds
- B: 150 pound person who can lift 175 pounds

Answer:
- A: relative strength = 200/250 = 0.80
- B: relative strength = 175/150 = 1.17
In strength testing, all muscle groups should be tested (specificity).
Muscular Strength and Endurance Assessment (Direct 1RM)

- Strength tests have been designed to measure muscular strength, muscular endurance, or a combination of the two.
  - Muscular strength usually is determined by the maximal amount of resistance an individual is able to lift in a single effort [one repetition maximum (1-RM)].
  - With the direct method, the person should continue trying until finding a weight that can be lifted only 1 time.
Muscular Strength and Endurance Assessment (Direct 1RM)

- Muscular endurance commonly is established by the maximum number of repetitions an individual can perform against a submaximal resistance.
Muscular Strength and Endurance Assessment (Indirect 1RM)

- A weight lifted between 2 and 20 repetitions at a comfortable pace, but with no resting interval
- Subsequently, the number of repetitions is applied in the following equation
- Equation: kg at # RM 2 to 20/[1.00 – (#RM * 0.02)]
  - #RM = number of repetitions possible
  - 1.00 = 100% as a decimal
  - 0.02 = 2 % as a decimal
- A retrial is provided, after resting 5 to 10 minutes, if 20 repetitions are exceeded
Resistance Training Principles

All principles of aerobic training also applies to resistance training including:

- Progression
  » Resistance must be built up slowly or risk of getting injured or too sore increases.

- Rest/recovery
  » Enough time to recover between workouts must be given to the body.
Facts about Resistance Training

- Everyone can gain strength and endurance
  - Including elderly and women
- NOT everyone will improve to the same extent (genetic predisposition)
  - Adaptations depend largely on the muscle fibers type distribution.
    » Fast twitch muscle fibers adapt more readily.
Myths about Resistance Training

- No pain - no gain
  - There is no need to be hurt to get benefits
  - The myth is based on overload principle which states the body must be challenged to improve.

- Makes your “muscle bound”
  - Weight training doesn't limit flexibility but in fact can increase it if performed throughout the full ROM

- Fat can be converted into muscle
  - Fat and muscle are separate tissues and you can't promote local fat loss by exercising a certain area.
Myths about Resistance Training

- Extra muscle turns to fat if not used or after stopping to train
  - A higher muscle mass increases BMR and energy expenditure.
  - Without training, muscle mass is lost.
    » If training is ceased while eating the same amount, the extra calories are converted to fat. (Muscle does not turn into fat)
Myths about Resistance Training

- Has masculinizing effect on women
  - Women won't develop the same muscles as men because they do not have as much testosterone
The FIT Formula Applied to Resistance Training

F

How often?

I

What resistance?

T

How many sets?
Type of Program

The FIT formula depends on the goal of training

- Muscular strength or size
  » muscular strength format (heavy weight / low repetition).
- Muscular endurance
  » muscular endurance format (low weight/high repetition)
- General muscular fitness
  » intermediate type of program should be used
Repetition Continuum

High Load
Low Reps

Mod Load
Mod Reps

Low Load
High Reps

Resistance (% of 1 RM)

Muscular Strength

Muscular Endurance

Repetitions
Stimulus for Strength

- **F**: every other day
- **I**: (80% 1RM)
- **T**: 3 sets < 8 reps

Muscular Strength

- **High Load Low Reps**
- **Mod Load Mod Reps**
- **Low Load High Reps**

Muscular Endurance
Stimulus for Endurance

Muscular Strength

Muscular Endurance

F: every other day
I: 40-70% 1RM
T: 1-2 sets 15-25 reps

- High Load Low Reps
- Mod Load Mod Reps
- Low Load High Reps

Resistence (% of 1 RM)

Repetitions
Stimulus for Overall Muscle Fitness

- **High Load Low Reps**
- **Mod Load Mod Reps**
- **Low Load High Reps**

**Muscular Strength**
- **F**: every other day
- **I**: 60-70% 1RM
- **T**: 1-2 sets 8 - 12 reps

**Muscular Endurance**

**Resistance (% of 1 RM)**

**Repetitions**
Muscular Strength and Endurance

Prescriptions

- Prescriptions for Muscular Endurance
  - For “anaerobic endurance” 15-25 repetitions.
  - For aerobic endurance > 25 repetitions.

- Olympic weight lifters exercise near 1-RM
  - 1-3 reps.
  - Working near 1 RM produces the greatest strength gains.
  - However, working constantly near 1 RM increases the risk for injury.

- Body builders tend to work with moderate resistance (60% of max.), but with more repetitions.
  - This promotes blood flow to the muscles, "pumping up the muscles."
  - This makes the muscles look much larger than they are in a relaxed state.
Concepts in Resistance Training

- "The pump"
  - Muscles aren't magically growing before your eyes. The increased size following a workout is due to blood “trapped” in muscles (venous return)

- Strength gain (several mechanisms involved)
  1. Neuromuscular: body improves ability to recruit motor units
  2. Hypertrophy (increased muscle size): strength depends on cross sectional area of muscle
  3. Hyperplasia (increased muscle cell number) - only seen in elite weightlifter
Concepts in Resistance Training

Strength gains

- Early (1st 8 wks) adaptations to RT seems to be due MOSTLY to neuromuscular changes
  » Rate and/or magnitude of neural firing
  » Number and/or type of motor units recruited
  » Coordination/communication between motor unit and muscles

- Long-term strength increases are largely the result of muscle fiber hypertrophy.
  » Increase in cross sectional area of muscle
Concepts in Resistance Training

![Graph showing contributions of different factors to gains in maximal strength over training time.](image-url)
**Concepts in Resistance Training**

- **Muscle fatigue**
  - When muscles produce too much LA, the pH of the cells decreases and muscles can't contract effectively.
  - With repeated lifting, some of the motor units become fatigued, and the body has to recruit new motor units that may be less conditioned.

- **Tone?**
  - Usually, people refer to tone as being definition.
  - It requires good muscle development and also a low percent body fat.
  - You can't turn fat into muscle and gain "tone".

- **Muscle soreness**
Delayed On-set Muscle Soreness (DOMS)

- Muscle soreness experienced 24-48 hours after exercise.
- The reason is unclear and still a debate
  - Slight tears & damage in connective tissue and muscle fiber.
  - Spasm.
  - Lack of oxygen in the area
  - Accumulation of by-products (lactic acid).
  - Most likely it’s a combination of some or all these factors.
Delayed On-set Muscle Soreness (DOMS)

- Prevention from DOMS
  - Gradual increase in exercise difficulty (intensity/duration/sets….)
  - Stretches
  - Warm-ups and cool downs
  - vitamin C indigestion (no strong evidence support this strategy)
Training Considerations

- Start slowly
  - To avoid excessive soreness and injuries
- Perform a warm-up set with very light weight for 12-20 repetitions.
Training Considerations

- Lifting speed is important for:
  - Fast lifting creates momentum and doesn't promote blood flow to the muscle, thus minimize muscle strength and size development
  - Incidences of injuries increases with fast lifting
Training Considerations

- Allow time for recovery between sets, exercises and sessions
  - muscles need to rest to adapt
- Expect plateaus
  - Plateaus are common in weight training.
  - Improvements will be rapid initially but will experience stages of plateaus.
  - Often it is necessary to try different routines to move past a plateau
Training Considerations

- Use proper technique (form)
  - Lift in a controlled manner
  - Exhale during effort
  - Exercise through the full ROM
  - Tendency to use too much weight typically results in poor technique
Training Considerations
(Exercise Through the Full ROM)

- Perform each exercise through a full range of motion, with emphasis on the end of the positive phase.

- Full range exercise movements are advantageous for:
  - Strengthening the prime movers at all degrees of the ROM
  - Stretching the antagonist muscles
  - Enhances both muscle strength and joint flexibility
Training Considerations
Selection of Magnitude of Weight

Examples of poor form or technique

– Using any sort of momentum in any exercise

  » Bouncing the bar off the chest in the bench press
  » Using hip and back extension to initiate bicep curls
  » Arching the back or bending backward under shoulder presses
  » Training at fast speeds.
Training Considerations

- Exercise both phases of the contraction
  - i.e. eccentric and concentric
  - Bring weight down slowly
  - Prevent injury
Types of Contractions

Concentric vs. Eccentric

Concentric (shortening)

LIFTING

Eccentric (lengthening)

LOWERING

Both phases can build muscle!
Training Considerations

It's preferable to perform exercise sets for muscle groups together.

– For example, perform bench press, incline bench press, followed by flys then move on to the next muscle group.

– Alternating between muscle groups (i.e. upper vs lower body muscles) does not fully target blood into any one muscle group to cause sufficient blood flow and stimulation to induce improvement.

» However, alternating between exercise sets for the same muscle group can be done (i.e. set for bench press followed by biceps curls)
Order of Exercise

- Large muscle groups first
- Small muscle groups first (pre-exhaust)
- Remain in the same groups of muscles

There are many different ways to order exercises within a workout.

See “On the Web11-10 for information on different training systems
Training Considerations

- Avoid eating too soon before and after exercise session to avoid overworking the heart and digestive system
  - Compromise blood delivery to the muscles
  - Never exercise while hungry – need nutrient for energy supply
Training Considerations
(Muscles Work in Pairs)

Avoid asymmetric training
- Exercise agonists and antagonists
- Prevent injuries

- While one muscle contracts and shortens the opposing muscle group relaxes and lengthens

- Design exercises for all major muscle groups (well-rounded program)
Factors Influencing Strength

- **Genetics**
  - Because of many issues
  - Muscle fiber type proportions (e.g. type IIx vs. IIa)
  - Bone length

- **Gender (males stronger than females)**
  - When strength is relative to body weight or to LBM females and males have nearly comparable strength.
  - Therefore, the main reason that males are stronger than females is the amount of muscle mass.

  - Testosterone builds muscle (anabolic effects)
Factors Influencing Strength

- **Age** (strength decreases with age)
  - Aging process vs ↓ physical activities

- **Anatomy**
  - The body built as a system of levers, thus the longer the lever arm the greater the strength for a muscle

- **Drugs**
  - Anabolic steroids
  - Human growth hormone
  - These drugs are highly dangerous and have permanent and life threatening consequences
Developing a Resistance Training Program

The key steps needed for planning a RTP

- Set goals
- Type of program
- Choice of equipment
- Muscle groups
- Order of exercises
- Format for sets
Goals provide motivation and a sense of purpose

**Setting Goals**

- **Specific**
  - Examples of specific goals:
  - Increase strength in bench press by 20 pounds in 3 months
  - Decrease percent body fat by 2% in 4 months
- **Challenging**
  - Give you something to strive for
- **Attainable**
  - Setting goals too high is the biggest problem for most people
Choice of Equipment

Weight Machines  Free Weights

There are advantages to both types of equipment.

See “On the Web”11-8 – variable resistance machines
Choice of Equipment

Some advantages of machines are:
- easy
- quick to use
- safer
- variable resistance.

Some advantages of free weights are:
- balanced muscle development
- more challenging and rewarding
- more adaptable to natural body movements
Choice of Equipment

• Free weights require more time and are more dangerous than machine weights, therefore most beginners should opt for machines when beginning a program.
Muscle Groups

- Sport specific training
  - Some may want to focus on muscles to improve performance in a certain sport

- Overall muscle balance
  - Avoid asymmetrical strength training

Most resistance training programs should include exercises for all major muscle groups.
Format for Sets

- Single sets
- Multiple sets
  - heavy to light (Oxford system)
  - light to heavy (DeLorme system)
- Circuit Training

- Most of available research indicates that strength and size gains are achieved with performing 1 set
- Elite athletes/patients might need more sets
Lab 11a Information
Evaluating Muscular Strength (1 RM)

- Find bench press and leg press stations
- Choose a weight that you can lift less than 10 times before fatiguing.
  - Record the exact number
- Use chart to estimate 1 RM based on weight and reps to fatigue
- Compute relative strength and complete rating chart
Lab 11b Information
Evaluating Muscular Endurance

- Perform push-up, pull-up and flexed-arm hang exercises - record repetitions or time (flexed-arm hang).
- Make ratings and describe results based on how you scored and how you thought you would score.
Choose exercises that work the major muscle groups of the body from any of the “Basic 8 exercises”.
  – Lab 10c: machine / free weight
  – Lab 10d: calisthenics / isometrics

Plan days to do exercises for 1 week

Monitor progress using log sheet and describe experiences