EXERCISE FOR STRENGTH

Randall L. Braddock, M.D., M.S.
rlbraddock@comcast.net
EXERCISE HAS MANY BENEFITS: It can...

Increase
- coronary artery size
- myocardial mass
- maximal cardiac output
- cardiac efficiency
- HDL

Decrease
- resting/exercise heart rate
- blood pressure
- Level out glucose homeostasis
- reduce catecholamine levels/sensitivity

Reverse NIDDM
Exercise Makes You Smarter

- Exercise produces IGF-1
- IGF-1 crosses blood-brain barrier and starts up production of a number of brain chemicals
  - One is brain-derived-neurotrophic-factor (BDNF), which causes:
    - More branches and synapses
    - More brain capillaries and blood volume
    - Less brain inflammation
    - More neurotransmitters of all types
    - More astrocytes to support brain structure
    - Causes new brain cell development
      - Especially in dentate gyrus of hippocampus
      - Increased size of frontal lobes
AARP Bulletin, April 2010 says

The current star in brain science is exercise.
Exercise has many positive effects

- Calming/Anti-anxiety
- Reduce incidence of Alzheimer’s
- Anti-depressant
- Improve balance and strength
- Prolong life
Exercise Prevents Alzheimers

- Study of 1880 in NYC from 1992-2006
  - Scarmeas N et al. JAMA 2009; 302:627-637
- Collected information of diet, exercise, and gave neuropsychological studies q1-2 years
- Reduced number with dementia and Alzheimers
- Prevention was dose-dependent
  - Some physical activity: 29-41% lower
  - Much physical activity: 37-50% lower
Strength and Cognitive Decline

- Study of 970 elderly in Chicago
- Strength had direct negative correlation with cognitive decline over 4 years
- Higher strength = less Alzheimer Disease over 4 years: (P < .001)
- This was true after adjusting for BMI, vascular disease, apolipoprotein E4, age, sex, education level, etc.

Boyle PA et al Arch Neurol 2009 66:1339-44
Exercise and ABI: Recent Review of Literature

- PM&R 2009;1:560+

Suggests that exercise might be useful in ABI
- “In light of strong evidence of positive effects in animal studies, more controlled, prospective human interventions are warranted to better explore the neurocognitive effects of physical exercise on persons with ABI.”
Exercise Prevents Silent Stroke

- Columbia Univ 2011
- Followed 1,238 elderly for 6 years
- 16% had silent stroke on brain scan at end of study
- 40% less strokes in moderate to intense exercise group

**Personal Health**

**Vigorous exercise can head off silent strokes in older people**

Older people who exercise regularly and relatively strenuously were less likely to have silent strokes — strokes that damage brain tissue without noticeable symptoms, according to a study last week in the online issue of the journal Neurology.

These can be a precursor to more damaging strokes. Silent strokes are also linked to more falls and disability as well as memory problems.

Researchers from Columbia University followed 1,238 people for about six years, until they reached an average age of 70.

Forty-three percent of study subjects said they didn’t exercise regularly. Thirty-six percent said they did light exercise like golfing, walking, or bowling, and 21 percent said they did moderate to intense exercise like hiking, tennis, swimming, biking, or jogging.

Brain scans done at the end of the study found that 16 percent of the participants had had silent strokes. Those who had done moderate to intense exercise were 40 percent less likely to have had silent strokes than those who did no regular exercise or light exercise.

— Stacey Burling
Exercise Critical for Children

- Hippocampus improves with exercise
- Vigorous workout as good as Ritalin for many kids with ADHD
- Exercise improves math-logic-reading
  - Taking PE right before reading class improved reading skills
- New push in many states for 30 minutes of PE per day in K-8
Americans are now swimming in more evidence that exercise is key, but only 21% meet activity guidelines.

Exercise kick-starts recovery

Analysis says it can outdo drugs after a stroke, heart attack

Nanci Hellmich
@nancibellmich
USA TODAY

Exercise may be as effective as medication in preventing early death in people who have had heart attacks or strokes, a new study suggests.

“Doctors should give their patients advice about the lifesaving benefits of exercise, and when possible, they should refer patients to rehabilitation programs with exercise programs,” says the study’s lead author, Huseyin Naci, a fellow at Harvard Medical School and a graduate student at the London School of Economics.

This adds to a large volume of research on the benefits of regular physical activity. Exercise has been shown to lower the risk of early death, help control weight and reduce the risk of heart disease, stroke, type 2 diabetes, depression, some types of cancer and a host of other conditions. Yet only about 21% of adults in the USA meet the government’s recommendations for physical activity, recent data show.

Naci and a colleague at Stanford University School of Medicine analyzed the results of 305 studies involving 339,274 people. They looked at early death in patients who had had strokes, heart attacks or heart failure or were at risk for developing type 2 diabetes. Only about 14,700 people participated in exercise trials. Exercise interventions varied among studies.

Among the findings reported in BMJ, a British medical journal:

- Among stroke patients, exercise was more effective than drugs. However, stroke patients who are capable of exercising may have been healthier to begin with than those who couldn’t exercise, Naci says.
- For people who had heart failure, diuretic drugs were more effective than exercise and all other types of drug treatment.
- For patients who had had heart attacks, exercise appeared to be as effective as drugs in preventing early deaths, Naci says.

He says more trials comparing the effectiveness of exercise and drugs are needed to help doctors and patients make the best treatment decisions. “Exercise should be considered as a viable alternative to, or in combination with, medications.”

New York cardiologist Richard Stein, a spokesman for the American Heart Association, says, “We are left with the same message we had before: Exercise therapy works. Drug therapy works. The combination of the two is the most reasonable approach.”

Timothy Church, a physician and director of preventive medicine research at the Pennington Biomedical Research Center in Baton Rouge, says the latest findings make “sense to me when you consider that exercise strengthens all parts of the human machine — the heart, the liver, the brain, the blood vessels, the muscles. The most powerful thing you can do for your health is to become active.”
Exercise as effective as drugs for prevention of common ailments

- 305 RCT studies
- 340,000 subjects
- Exercise and drugs equally effective for prevention of heart disease and diabetes
- Stroke: exercise more effective for prevention
- Heart failure: diuretics more effective than exercise or other drugs
- H. Naci 2013, BMJ: 347+
- Meta-analysis
Los Angeles

Study: Fitness boosts brainpower in kids

MCCLATCHY-TRIBUNE

LOS ANGELES - Forget that stereotype about the dumb jock. A new study reveals that kids who are more physically fit score higher on geography tests, too.

Previous research has found that out-of-shape kids get lower grades in school and perform worse on tasks involving memory and other types of cognitive function.

For the new study, researchers at the University of Illinois at Urbana-Champaign recruited 48 kids who were 9 or 10 years old and asked them to learn the names of 10 fictional regions on a map.

Half ranked in the top 30 percent of fitness (as measured by a treadmill test) for kids their age and gender; the other half ranked in the bottom 30 percent. Besides that, both groups were basically the same.

The children spent one day using iPads to learn the fictitious maps. In some cases, they were tested by quizzes; in others, there was only memorization. Their recall was tested the next day.

Overall, the kids who were physically fit got an average score of 54.2 percent and the kids who were not fit got an average score of 44.2 percent. The difference was more pronounced when children were asked to remember the maps they had learned without the benefit of quizzes - the fit kids scored 43 percent on average, while the unfit kids scored...
Level of STRENGTH also affects the Mortality Rate

- Muscle strength is **Inversely and Independently** associated with mortality rate from all causes
- Prospective cohort study of 8762 men for mean 18 years age 20-80
- Compared with 1RM measures of strength and fitness (treadmill testing)
  - Controlled for fitness, BMI, FH of CVD, Age, smoking, ETOH, general health, etc.
Strength and Executive Functions

- 41 elderly women
- Quad strength correlated with Executive Functions on neuropsychological tests
Exercise Improves Fertility

- 189 men in Rochester, NY
- 20 hours of TV per week = 40% drop in sperm count
- Exercise 15 hours/week = 73% higher sperm count
  - British J Sports Med 2013
What Happens If You Don’t Exercise?

“The functional capacity of any organ is dependent within physiological limits upon the intensity and frequency of its activity.”

Fritz Kottke, JAMA, 1966
What Happens If You Don’t Exercise?

IF YOU DON’T USE IT, YOU LOSE IT!

William Bortz  Journal of the American Geriatric Society 1980
Muscle Atrophy is an Active Process

- Gelatinase A (one of many metalloproteinases)
  - Plays an active role in muscle atrophy
  - Disrupts basement membrane
    - Allows influx of calcium and iron
    - Triggers degeneration of myofibers by activation of proteases
America: Land of

- The Free
- The Brave
- And the Sedentary

For the first time in our history, Americans don’t have to exercise. They must choose to exercise.
National Lifestyle Crisis

Americans are now dying mainly of their own lifestyle (mainly involving nutrition, smoking, and lack of exercise).

- Obesity
- Diabetes
- Heart Disease
- Stroke
- Cancer
People have to exercise in developing nations
Sedentary Children

- AHA says that children now take 90 seconds longer to run a mile than 30 years ago.
- Due to safety concerns, TV, video games, lack of gym in school.

Exercising is declining in children worldwide

Villagers recall days of outdoor play, activities

By KAYLA COLLIER
DAILY SUN STAFF WRITER

THE VILLAGES – Joe Santoro spent his childhood playing outside when he wasn’t at school.

“When I was a child, I lived in the Bronx, N.Y. You would come home, put your stuff down and go outside to play and ride your bike,” said Santoro, of the Village of Bridgeport at Lake Miona. “You watched a little TV, but then you went back outside until our mothers called us back in. Now, kids play a lot of video games, but there needs to be a moderate balance with exercise.”

Physical activity is healthy, don’t run as fast or as far as their parents and grandparents did when they were young.

Children who were analyzed in the American Heart Association study took 90 seconds longer to run a mile than children 30 years ago, a 5 percent decrease per decade since 1975 for children ages 9 to 17.

Dr. Marcus Kilpatrick, associate professor in the school of Physical Education and Exercise Science at the University of South Florida, said the decrease in exercise is the result of many circumstances.

“Reduced fitness in children is linked to a reduction in school-based physical education, decreased travel by foot and bicycle – due in part to concerns related to safety – and associated increase in body weight, which tends to limit physical performance,” Kilpat-
Study finds ‘mind-boggling’ increase in morbidly obese

In 5 years, ranks up by 2.6 million

By Nanci Hellmich
USA TODAY

The prevalence of American adults who are 100 or more pounds over a healthy weight has risen dramatically since 2000, a study released Monday shows.

About 3% of people, or 6.8 million adults, were morbidly obese in 2005, up from 2% or 4.2 million people in 2000, says Roland Sturm, an economist with the Rand Corp., a non-profit think tank.

The evidence of such a significant increase in the number of Americans who are extremely heavy "is mind-boggling," he says.

Sturm analyzed government data on about 1.5 million people who reported their own weights and heights. Participants were categorized as severely or morbidly obese if they had a body mass index (a height-weight ratio) of 40 or higher.

According to government data, about 66% of people in the USA are now either overweight or obese, which is defined as 30 or more pounds over a healthy weight.

Obesity increases a person's risk of contracting numerous diseases, including diabetes, heart diseases and cancer.

Sturm's study, which was released Monday on the website of the journal Public Health, shows that 24.6% of people were obese in 2005, up from 20% in 2000. That's an increase of 24%.

People usually under-report their weight, so the percentage of people who are morbidly obese is actually higher than 3%, Sturm says.

A large government survey in which people are actually weighed and measured suggests that about 5% of U.S. adults are morbidly obese and a third are obese, he says.

Sturm says his analysis highlights the dramatic increase in the number of morbidly obese people over a relatively short period of time.

"Even though we've had an explosion of bariatric surgery in that time, it doesn't seem to have made a dent in these numbers," he says. Bariatric surgery often reduces the size of the stomach.

For years, some experts have believed that severe obesity was a rare condition that affected a fixed percentage of the population that might be more predisposed to weight gain for genetic or metabolic reasons, Sturm says.

"But these numbers show the trend is really paralleling what is going on in our society," he says. To help reverse the numbers, "we need to move to a healthier environment with friendlier staircases and more walkable environments," Sturm says.

George Blackburn, associate director of nutrition at Harvard Medical School, calls the increase in the percent of severely obese people a catastrophe.

"It is an emergency because the disability, the discrimination and the health-care costs for this population are enormous," he says.
Diabetes up 15% in U.S. to 24 million

By Elizabeth Lopatto
BLOOMBERG NEWS

The number of Americans with diabetes increased by 15 percent in two years to nearly 24 million, public health officials reported yesterday.

Almost 8 percent of the total population now has the disease, which is linked to obesity and sedentary living, according to the U.S. Centers for Disease Control and Prevention.

The latest numbers are estimates for 2007 and include people who have been diagnosed with diabetes as well as those who likely have it but don’t know it, the agency said.

The estimated number of people with undiagnosed diabetes actually went down, to 6.2 million in 2007 from 5.7 million in 2005, indicating an increased awareness about the disease, the CDC said.

But an increase in diagnosed cases more than made up the difference. And the CDC warned that another 57 million people were estimated to have pre-diabetes, a condition that puts them at increased risk for the disease.

Prevalence varied dramatically by age, race and ethnicity, as it has in the past. Nearly 25 percent of Americans age 60 and older had either diagnosed or undiagnosed diabetes in 2007, the CDC said.

When the agency adjusted for population age differences among different groups in the United States, it found diabetes rates among American Indians and Alaska natives of 16.5 percent; blacks, 11.8 percent; Hispanics, 10.4 percent; Asians, 7.5 percent, and whites, 6.6 percent.

Diabetes is the seventh-leading cause of death in the U.S. and can lead to heart disease, blindness, kidney failure and amputation, according to the National Institutes of Health. Two-thirds of diabetics eventually die from heart attack or stroke, many of them unaware of their heightened risks.

Worldwide, the number of people with diabetes is expected to double to 366 million by 2030, according to the World Health Organization.
Obesity, Diabetes in SCI

- Study of 1938 male veterans with SCI
- BMI 18-25: 50% higher DM
- BMI 26-30: 300% higher DM

  Rajan et al. AJPM&R 2010;89:353+
A Chinese man has his resting pulse taken at a Tianjin clinic. An estimated 200 million Chinese adults are considered overweight, with about 75 million heavy enough to be considered obese.

With wealth comes fat, the Chinese are finding...
Exercise Words Heard Around the Gym

- Free Weights
- Weight Machines
- Closed Chain
- Open Chain
- Kinetic Chain
Remember the Kinetic Chain

- Shoulder problem can begin somewhere else
- For throwing/racquet athletes, the shoulder participates in a kinetic chain of events
  - Photo of Tom Seaver
Force

- Force is mass times acceleration in a specific direction
- $F = ma$

- Newton (N) = 1 kg/M/sec
- Force of Gravity: Kilopond = 9.81 Newtons
WORK

- Work is force times distance \((W=Fd)\)
- Commonly measured in Joules
- Joule = 1 Newton-Meter
POWER

Rate of performing work
usually measured in Watts or KPM/min
Maximal muscle tension or force

Limiting Strength
- Maximum strength achievable
- What limits our strength?
FACTORS AFFECTING STRENGTH AND ITS MEASUREMENT

- Muscle length
- Lever arm
- Angle of pull
- Site of origin
- Site of insertion
- External factors
- Motivation

Measurement problem: Strength can vary in the same day for the same task by 10-20%
Strength Test/Retest Reliability

- Same isokinetic test repeated weekly
- High degree of test-retest reliability
- But: smallest change that would indicate real improvement in strength was 15-23%
STRENGTH

- Is proportional to the cross-sectional area of muscle
  - Women can increase it by 15%
  - Young to Middle age men can increase it 40%
Strength Building in Women

- Women don’t get “muscle bound” look
- Women with very large, well-defined muscles typically have used anabolic steroids or human growth hormone
Body Builders vs. Weight Lifters
Paul Anderson 1956 Gold Medal 657# raw bench press
3 Principles of Strength Training

- Overload
- Specificity
- Variability
LAW OF SPECIFICITY

- The best exercise for doing a specific activity is:
- That activity
Strength increases at first due to Neural Training

- Begins immediately!

“The initial increase in strength on progressive resistance exercise occurs at a rate far greater than can be accounted for by morphological changes within the muscle.”

- DeLorme & Watkins 1951
Neural Factors in Strength

- Weight lifting strength increase due to neural factors in first two weeks, muscle hypertrophy later
  - Moratani & DeVries 1979
- Six weeks of exercise produced increased synchrony of firing of motor units
- Integrated EMG increases early in exercise
  - Hakkinen & Kimo 1983
Neural Factors in Strength

This is why strengthening one extremity can cause an increase in strength in the opposite limb

Muscle Hypertrophy

- Takes 2-7 weeks to start
  - Due to short LOS, patients on acute rehab do not stay long enough to get hypertrophy
Muscle Hypertrophy

- INCREASE IN
  - Muscle mass
  - Cross-sectional area
  - Myofibril size and # in each Type 2 muscle fiber
  - In rare circumstances increased # of fibers
- Connective tissue and tendons adapt
Hypertrophy Stimulus?

- Anoxia? Metabolic products? Other?
- The stimulus is powerful as hypertrophy occurs in spite of
  - negative nitrogen balance
  - use of cortisone
  - absence of growth hormone or insulin
  - inadequate nutrition
- Occurs even in tissue culture
Muscle Satellite Cells

- Hypertrophy requires satellite cells (muscle stem cells)
- Muscles in which satellite cells are destroyed by radiation will not hypertrophy
- Satellite cells act by enhancing repair of muscles
  - Barton-Davis et al 1998
Muscle Satellite Cells

- Bout of maximal eccentric exercise produced
  - 141% more Satellite Cells (men 23-35 yoa)
  - 51% more Satellite Cells (men 60-75 yoa)
    - Measured 24 hours after exercise
    - Vastus lateralis biopsy
HGF and Satellite Cells After Exercise

- Quad muscle biopsies before/after eccentric exercise in 8 subjects
- Hepatocyte Growth Factor (HGF) believed to be the factor that turns on the Satellite Cells
- After exercise, both HGF concentration and number of Satellite Cells increased
Serum HGF after Exercise
Satellite Cells After Exercise

![Graph showing N-CAM+ Cells (% Myonuclei) over time (hr): PRE, 4, 24, 72, 120. The graph indicates changes in N-CAM+ cells post-exercise with statistical significance marked by asterisks (*) and other symbols.](image)
MUSCLE STRENGTH IS ALSO AFFECTED BY

- Hormones
  - Strength increased immediately by epinephrine; norepinephrine
- Some steroids enhance hypertrophy over time
  - Do steroids increase strength independent of hypertrophy?
- Psychological/Behavioral Factors
  - Some try harder than others
Insulin-Like Growth Factor I

- Rat studies have shown that injecting a recombinant adenovirus into muscle causes overexpression of IGF-I
  - Produces muscle hypertrophy
  - Prevents aging loss of IIb fibers
  - Works by stimulating satellite cells for muscle repair and increased cellular development
    - Barton-Davis et al 1998
Anabolic Steroids

- Oxandrolone, nandrolone, recombinant human growth hormone, etc

Uses
- Illegal for athletes
- Lifestyle drug
- Legitimate medical use
Oxandrolone uses

- Burns
- Duchenne MD
- High quad pulmonary function
- Aids wasting syndrome
- Wound Healing
- Research favorable - larger studies needed
  - Little androgenizing effect
  - Especially helpful when catabolic steroids being used?
Children and Steroids Caution

- Faigenbaum et al Pediatrics 1998
- Surveyed 900 middle school students
  - 2.6% of males and 2.8% of females reported using steroids
  - 35% of users said they would use in the future
  - Only 54% of users thought steroids were harmful
50 Athletes Axed in Beijing Olympics

- Greece 15 (11 weight lifters)
- Bulgaria 11 (all weight lifters)
- Russia 10
- China 3
- Romania 3
- Italy 2
- 1 each: Brazil, Denmark, India (female weight lifter), Jamaica, Netherlands and USA
Drugs in 2008 Olympic Athletes

- EPO
  - Increases hematocrit for endurance events
- Clembuterol (not FDA approved in USA)
  - Beta2 adrenergic agonist
  - Decongestant, brochodilator
  - Stimulant and fat burner
  - Street drug for weight loss and looking “cut”
- Methyltrienolone (15 from Greece)
  - Very powerful androgenic steroid
  - Very toxic to the liver, can be fatal
  - Never legal anywhere
What suppresses muscle growth?

- Inactivity
- Myostatin
Role of Myostatin

- Discovered in mice 1992 (Johns Hopkins)
- Mammals/humans without gene for Myostatin develop huge muscle mass
  - German baby born with myostatin mutation could lift 7 lb barbells in each hand at age 4
- One of many Growth Factor-Beta Proteins
- Dampens muscle growth, especially in the embryo
  - AKA Growth Differentiation Factor 8 (GDF8)
Anti-Myostatin Vaccine

- Helped function but not histology in LGMD mouse
  - S. Bogdanovich, Muscle Nerve 37:308-16 2008

- Chinese used it in normal mice: It increased
  - Body weight
  - Muscle mass
  - Endurance
Naturally occurring myostatin inhibitors are being studied, including:

- Follistatin
- Follistatin-related gene (FLRG)
- Growth Factor and Differentiation factor-associated serum protein-1 (GASP-1)

These proteins bind to myostatin in the serum and inhibit binding of myostatin to membrane receptors

CONCENTRIC AND ECCENTRIC CONTRACTION

- CONCENTRIC
  - Muscle tenses and shortens

- ECCENTRIC
  - Muscle tenses while being lengthened
Type II Fibers Provide Most of the Power

- Fast fibers have 4X more power than slow fibers
- Velocity of movement changes the power contribution
- At high velocity, power is mainly due to fast fibers
Three major types of strength exercise

- **ISOTONIC**
  - Dynamic force against a moveable object

- **ISOMETRIC**
  - Dynamic force against an immovable object

- **ISOKINETIC**
  - Dynamic force against a preset rate limiting device
  - (Does not exist in nature)
ISOTONIC EXERCISE

ADVANTAGES

- Aids flexibility (full ROM)
- Real world activity
- Can be done without expensive equipment
- Easy to gauge patient effort
- Can be Concentric and/or Eccentric
ISOTONIC EXERCISE

DISADVANTAGES

- Requires joint movement
- Can be dangerous if not done correctly
- Difficult to computerize
Isotonic Weight Equipment causes many injuries each year

- 7000 Strains and sprains
- 6000 Lacerations
- 5000 Contusions/abrasions
- 3700 Fractures
- Many other injuries including amputations and even death

Mary Roach, National Injury Information Clearinghouse
ISOMETRIC EXERCISE

ADVANTAGES:

- No joint motion required
- Less painful
- Less joint injury
- Use it constantly to maintain balance and stability
Isometric Exercise

DISADVANTAGES

- No joint motion
- Joint angle specific strengthening
- Can cause hypertension
- Shutoff of muscle blood supply
- Little stimulus for hypertrophy or endurance
- Hard to gauge effort of the patient
TYPES OF ISOMETRIC EXERCISE

- Rule of Tens
  - 10 contractions held for 10 seconds

- BRIME
  - Brief repetitive isometric exercise
  - Based on 6 second contractions done at intervals
ISOKINETIC EXERCISE

ADVANTAGES

- Strengthens at full joint Range of Motion
- Strengthens at different speeds of movement
- Easily computerized
- Provides objective data on peak muscle torque, power, and endurance at reproducible velocities
- Smooth feeling during exercise
ISOKINETIC

DISADVANTAGES
- Does not occur in nature
- Not proven better than isotonic
- Expensive equipment required
- Usually only concentric
- Rotation rates too slow for the real world
  - 300 degrees/second maximum
  - 7000 degrees/second for throwing motion
Resistance Band/Cord Exercise

- Popular due to its portability
- Simulations of functional or sports activities such as throwing or kicking
- Caveat: Recommend latex-free bands
Length-Tension Relationships: The BLIX Diagram

- A - Total tension
- B - Tension due to active contraction
- C - Passive tension due to stretch
PROGRESSIVE RESISTIVE EXERCISE (PRE)

DeLorme 1945
- Find 10 RM
- Then increase from 10% to 100% of 10 RM

DeLorme 1948
- Do 10 at 50% 10 RM
- Then increase at 25% increments
Regressive Resistive Exercise (RRE)

- Zinovieff or Oxford Technique 1951
  - Warmup
  - Do 10 at 100% of 10 RM
  - Decrease in 10% increments

- McGovern and Luscome 1953
  - Warmup
  - Do 10 at 100% 10 RM
  - Decrease in 25% increments
Daily Adjusted Progressive Resistive Exercise

- Uses a 6 RM technique
- Set 1: 10 reps at 50% of 6 RM
- Set 2: 6 reps at 75% of 6 RM
- Set 3: As many reps as possible at 100% 6 RM
- Set 4: As many reps as possible at new weight
  - If <5 reps in set 3, lower 5#
  - If 6 reps in set 3, leave weight the same
  - If >7 reps in set 3, increase weight 5#
Strength Relationships Diagram
from Knuttgen, 1976
Strength Exercise Advice

- Use high weight, low rep in most cases
- Use low-moderate weight, high rep in special cases
  - Prevent injury or re-injury
  - Children
  - Training for a highly repetitive task

**KEY:** MUST EXERCISE TO FATIGUE
Elderly and Sarcopenia

- Age-associated reduction in muscle mass to >2 SD below normal lean body mass using DEXA scanning
- Incidence of 10% over 70 and 20% over 80 yoa
- Costs US 18 billion dollars
  - Falls
  - Decreased ADL
Critical Role of Exercise in Aging

Many of the things that happen with aging are actually largely due to lack of exercise:
- Decreased strength, flexibility, endurance
- Decreased total body muscle
- Increased total body fat
- Osteoporosis
- Decreased Range of Motion
Weakness in Elderly not Inevitable

- Masters athletes (70 yoa) who did resistance exercise had strength higher than sedentary younger men.
- Lifelong resistance exercise protects against age-associated strength loss.
Muscle strengthening with resistance exercise is the main intervention that can reduce falls in adults.


Would anabolic agents help prevent falls?
Children and Strength Training

- Falk and Tenebaum Sports Med 1996
  - Meta-analysis of many studies
  - Boys and Girls make strength gains of 13-30%
  - Training 2X/week might be enough

- Faigenbaum et al Pediatrics 1999
  - Kids gained up to 41% more strength
  - Recommend moderate weight/high rep rather than high weight/low rep
Jack LaLanne got America interested in exercise

- Died in 2011 at 96.
  - At age 60 he swam from Alcatraz to Fisherman’s Wharf while handcuffed, shackled, and towing a boat.
- Jack LaLanne said:
  - “If you can’t spend 15, 20 or 30 minutes four times a week taking care of your body, there’s got to be something wrong with you.”
Personal Advice

- Keep Active
- Build exercise into your life
- There are a lot of choices…
COMBINING WORK & EXERCISE

- Invented by Dr. James Levine, obesity researcher at Mayo
- Steelcase Co. calls it the Walkstation
- Burn up to 100 calories an hour doing deskwork
- $4,000
Combining work and exercise
Happy Exercising!

Remember:

More People Rust Out than Wear Out!
QUESTIONS? COMMENTS?

rlbraddom@comcast.net
Tips on Exercise and Traveling

- **www.run.com**
  - 11,200 safe running routes in 50 states and many other countries
  - 2 mile, 5 mile, and longer routes

- **www.hotelgymreview.com**
  - Reviews exercise rooms in hotels

- Sheratons have free “workout in a bag” kit
- Exercise TV available in many hotel rooms

- **www.athleticmindedtraveler.com/home.php**
- **www.slowtrav.com**