ALTERATIONS IN NUTRITIONAL STATUS
Nutritional Status: the condition of the body related to the availability and use of nutrients.

Metabolism: the process through which nutrients like carbohydrates, fats and proteins are broken down and converted into energy.
NUTRITIONAL STATUS

- Calorie: energy measured as a unit of heat
  - Kilocalorie: (kcal) the amount of energy needed to raise the temperature of 1 kg of water by 1° C
- More than 90% of body’s energy is stored in adipose tissue (fat)
- Adipose tissue generates energy, provides insulation and cushions organs
ADIPOSE TISSUE

- Mature cells do not divide
- White fat: more prevalent, 10-20% of body weight in males, 15-25% in females
  - Composed of triglycerides which are made from dietary fat and carbohydrates, efficient energy storage
- Brown fat: responsible for generating heat, more prevalent in neonates and hibernating animals
**ANABOLISM VS. CATABOLISM**

- **Anabolism:** metabolic storage and production of cell contents
  - Uses energy
  - Building up things, takes energy to do so.

- **Catabolism:** breakdown of complex products that produces energy
  - Breakdown fats/carbos and use them to produce energy.
ENERGY METABOLISM

- Metabolites: the intermediate substances and breakdown products
- ATP (adenosine triphosphate): a compound produced by the breakdown of food that the body stores and uses as the primary energy source.
Glucose: another fuel source
- Brain and nerves almost exclusively use glucose as an energy source

Liver regulates glucose levels in the blood
- Dietary glucose is absorbed then transported to the liver
- If blood sugar levels are adequate or high, the liver removes glucose and stores it as triglycerides or glycogen
- If blood sugar levels are low, the liver releases glucose into the blood stream
GLYCOGENOLYSIS

- Glycogen is primarily stored in liver and skeletal muscle
  - Small amounts stored in skin, glands
- Glycogenolysis: the breakdown of glycogen to release glucose
  - Involved hormones:
    - Glucagon: liver
    - Epinephrine: muscle
GLUCONEOGENESIS

- The production of glucose
- Mostly occurs in the liver
- Occurs when the body is deprived of food sources or in a low carbohydrate diet
FAT METABOLISM

- Fats provide more energy per gram than glucose (9 kcal vs 4 kcal)
- Fats can be derived from food or released from fat storage
- After being broken down, fats travel to the liver and are removed from the blood and used as energy
- Ketones are byproducts of fat breakdown
  - Used by the brain
  - Can cause acidosis if the muscle breakdown exceeds energy usage

Ketones can be used for energy. Not the preferred energy. Not the preferred.

Diabetics can have this happen. Breathing gets very heavy to blow off those extra acids. In kids, insulin plummets, body is overloaded with ketones.
PROTEIN METABOLISM

- Proteins make up the solid structure of our body
- Made of amino acids
- Liver can break down protein to produce glucose

www.dkimages.com/discover/previews/836/965507.JPG
ENERGY EXPENDITURE

- Basal metabolic rate: the chemical reactions happening at rest (50-70% of energy needs)
- Diet-induced thermogenesis: the energy used for digestion and usage of food
- Exercise-induced thermogenesis: the amount of energy needed for activity
- Thermogenesis necessary for environmental conditions
NUTRITIONAL NEEDS

- Calories: depends on age, sex and weight
- Protein
- Fat: the most concentrated form of energy
  - Saturated fats raise blood cholesterol
  - Unsaturated (mono or poly) lower blood cholesterol
- Carbohydrates: simple, complex and undigested
  - No specific requirement but 50 grams/day prevents ketosis
Vitamins: catalysts in chemical reactions

- **Fat soluble**: A, D, E, K
- **Water soluble**: B₁, B₂, B₆, B₁₂, pantothenic acid, niacin, folic acid, biotin, vitamin C

Minerals: calcium, sodium, potassium, etc.

Fiber
ANTHROPOMETRIC MEASUREMENTS

- Height
- Weight
- Circumference
  - Waist circ should be <40” in men, <35” women
- Skinfold thickness
- Body Mass Index (BMI) = weight (kg)/height (m^2)
  - Underweight <18.5
  - Normal 18.5-24.9
  - Overweight 25-29.9
  - Obesity >30

Other categories beyond obese. All of this comes from insurance co stats.
OBESITY

- Obesity = excess body fat
- The second leading cause of preventable death in the U.S.
- Over 30% of Americans are obese and the number of people with severe obesity is increasing
- http://health.msn.com/reports/obesity/default.aspx shows a map of the epidemic
OBESITY

- Genetic factors: 30-40% heritable

- Environmental factors

- Increased caloric intake coupled with lower energy expenditures

- Waist to hip ratio >1.0 in men and 0.8 in women indicates upper body (abdominal) obesity
UPPER BODY OBESITY (APPLE)  
CENTRAL, ABDOMINAL, MALE

LOWER BODY OBESITY (PEAR)  
PERIPHERAL, GLUTEAL, FEMALE

upload.wikimedia.org/wikipedia/commons/thumb/obese male

www.abc.net.au/.../img/health/obese290307.jpg
OBESITY

- Waist circumference correlates with abdominal fat, higher numbers associated with increased health risks
  - >40” in men and >35” in women
  - Increased risks of ischemic heart disease, stroke, and death
  - Hypertension, elevated triglycerides, diabetes, breast/prostate/colon cancer, gallbladder disease, infertility, asthma, sleep apnea, arthritis
- Peripheral obesity does **not** increase risk for heart disease
TREATMENT OF OBESITY

- Prevention is key
- Reduced calorie/low fat diet
- Increased physical activity
- Behavioral therapy
- Medications
- Surgery

Goal of weight loss is 1-2 lbs/week

- Prevent at a young age more successful than treating it later.
- Behavioral therapy = stress eating

Gastric bypass, lapband.

Lose weight faster than this and will probably gain it right back.
TREATMENT OF OBESITY

- Reduce calorie intake 300-500 cal/day for overweight patients, 500-1000/day for obese
- Low saturated fat with <30% of calories from fat
- 30-60 minutes of moderately intense activity every day
- Surgical candidates have a BMI >40 or >35 along with a co-morbid condition or failed medical therapy

3500 cals = 1 lb of body weight.

low end. go for 60-90 per day for better results.
CHILDHOOD OBESITY

- 15% of children ages 6-19 are overweight
- Risk of diabetes, hyperlipidemia, hypertension
- Increased risk when one or both parents are overweight
- Diet, inactivity contribute
- Young children can simply maintain weight
- Severely obese or older children should aim for loss of 1 pound a month
UNDERNUTRITION

- Deprivation of all food or of one nutrient
- Can be willful or due to a health problem
- 195 million children worldwide are malnourished
- Two types of malnutrition (usually in children):
  - Marasmus
  - Kwashiorkor
MARASMUS

- Loss of muscle mass and fat stores
- Inadequate calories  \( \text{(cause)} \)
- Stunted growth  \( \text{(results...)} \)
- Wasting
- Low body temp, heart rate and blood pressure
- Normal liver function  \( \text{not so in the next kind...} \)

www.thachers.org/images/marasmus.jpg
KWASHIORKOR

- Protein deficiency
- Occurs when children are fed overly starchy diet
- Edema
- Discolored hair
- Skeletal muscle wasting
- Enlarged liver

if fed correctly, could recover. however, GI tract will degenerate in response to this malnutrition, so you cannot just shift them to a regular diet. gradual increase in protein so system can heal itself.
PROTEIN-CALORIE MALNUTRITION

Most malnutrition is a combination of protein and caloric malnutrition.

- Can occur in trauma, sepsis, cancer, AIDS
- Accelerated muscle/protein breakdown
- Loss of protein in blood causes edema
- Atrophy in GI tract causes malabsorption
- Decrease in immune cells, wound healing
- Decreased cardiac output
- Decreased respiratory muscles

So if you aren't nourishing someone properly in the hospital this happens, hence the wider risk of pneumonia.
EATING DISORDERS

- 5 million Americans affected each year
- Typically in young women but 40% of binge eating disorders are in men
- Symptoms can often overlap
- Preoccupation with weight and excessive self-evaluation of weight
- Often accompanied by psychiatric disorders and possible suicidality
FEMALE ATHLETE TRIAD

- Disordered eating
  - Amenorrhea
    + Low estrogen levels
    + Low estrogen
    + Low calcium
    + Stress fractures
  - Osteoporosis
    + Low estrogen
    + Low calcium
ANOREXIA NERVOSA

- Intense fear of gaining weight and becoming fat
- Refusal to maintain normal weight for height
- Disturbance in perceived body image
- Amenorrhea

- Mortality rate is 0.56% per year (12 times normal for young women in same age groups)
ANOREXIA NERVOSA

- Caloric restriction
- Increased physical activity
- Decreased estrogen leading to osteoporosis
- Vertebral compression fractures because bones are weakened
- Constipation perpetuates problems with laxatives which are also used for weight loss.
- Cold intolerance
- Bradycardia low heart rate
- Hypotension
- Lanugo growth of fine body hair.
- Electrolyte abnormalities low sodium plus abuse of diuretics = hyponatremia leading to heart arrhythmias
- Sudden death due to heart failure
BULIMIA NERVOSA

- Affects up to 3% of young women
- 10 times more common in women
- Recurrent binge eating (2 times per week for 3 months)
- Inappropriate compensation for binges
- Self-evaluation is influenced by weight
- Usually aware that the behavior is abnormal

vomit, laxatives, etc.

self-judge as bad unless...
BULIMIA

- **Purging:**
  - Vomiting
  - Laxative abuse
  - Diuretic abuse

- **Non-purging:**
  - Fasting episodes
  - Excessive exercise

thus an overlap with anorexia which results in some of the same behaviors. benchmark is the binging episodes.
BULIMIA

- Dental disorders
- Parotitis
- Esophagitis/reflux
- Electrolyte abnormalities
  + Low potassium

acids from stomach. can also see some callousing or scabs from there the teeth and knuckles

parotid glands swell due to the constant vomiting

painful swallowing, esophagus is swollen.
BINGE EATING DISORDER

- Recurrent episodes of binge eating (2 days a week for 6 months) and at least three of the following criteria:
  + Eating rapidly
  + Eating until uncomfortably full
  + Eating large amounts when not hungry
  + Eating alone
  + Guilt, depression or disgust

- Most are overweight
Activity: The process of energy expenditure for the purpose of accomplishing an effect

Exercise: Movement and energy expenditure to condition the body, performed on a regular basis

Benefits include: slowing or reversal of atherosclerosis, increased HDL, decreased LDL, regulation of blood pressure and glucose, improves mood, weight control
AEROBIC (ENDURANCE) EXERCISE

www.maratonasantantonio.com/upload/file_ima_8

ANAEROBIC (ISOMETRIC, RESISTANCE)

universalsports.nbcssports.com

EXERCISE
<table>
<thead>
<tr>
<th>AEROBIC</th>
<th>ANAEROBIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses oxygen to transform glucose, fatty acids, etc into energy</td>
<td>Muscles contract against an immovable force</td>
</tr>
<tr>
<td>Change in muscle length (contraction and elongation)</td>
<td>No change in muscle length</td>
</tr>
<tr>
<td>Results in muscles using oxygen more efficiently</td>
<td>Results in muscle hypertrophy (mass)</td>
</tr>
<tr>
<td>No muscle hypertrophy</td>
<td>Increase in muscle tone</td>
</tr>
</tbody>
</table>
EXERCISE

Four components:

- Cardiopulmonary fitness
- Muscle strength, flexibility and endurance
- Availability of energy to meet demands,
- Motivation and mental endurance
CARDIOPULMONARY RESPONSES

- Heart, lung and blood vessels
- Supply oxygen and energy to working muscles
- Exchange oxygen and carbon dioxide
- VO₂ max=maximal oxygen consumption
  + The capacity to deliver oxygen, the limiting factor

Measure used in fitness evaluation - like mask used during stress tests. How much O₂ you can possibly consume. If low you are poorly conditioned, if high you're right on dude.
CARDIOPULMONARY RESPONSES

- Central nervous system and local neural regulation
  - blood vessels dilate to skeletal muscles to provide increased flow, but vasoconstrict to the places that don’t need it.
- Vasodilation to skeletal muscles, vasoconstriction to kidneys & GI tract
- Increased cardiac output, heart rate & blood pressure
  - if poorly conditioned, BP might go too high in response.
- Increased angiogenesis to muscles
- Increased oxygen/carbon dioxide exchange
NEUROMUSCULAR RESPONSES

- Muscle strength: the ability to produce force against resistance
- Flexibility: the range of movement of joints
- Muscle endurance: the ability to perform increased activity for an extended time
SKELETAL MUSCLE FIBERS

- Type I: Slow twitch, red (dark)
  + Smaller, less force, more efficient due to high concentration of mitochondria and myoglobin
  + Low-intensity, endurance, larger muscles
  + Quickly decondition due to disuse
- Type II: Fast twitch, white (light)
  + Larger fibers, higher ATPase activity
  + Smaller muscles (arm, eye), high intensity work
  + Sprinting, weight lifting
- Heredity and activity determine the distribution
METABOLIC AND THERMAL RESPONSES

- muscles store only enough ATP to power contraction for a few seconds, then extra ATP must be generated
  - Creatine phosphate: unique to muscle fibers
  - Glycogen: used early in activity
  - Fatty acids: used in prolonged exercise
THERMAL RESPONSES

- Blood flow increased to skin
- Vasodilation
- Sweating
  - With training, the body increases the rate of sweat production and starts sweating earlier in exercise
OTHER SYSTEMIC EFFECTS

- GI: blood flow shunted away from GI tract
  - Decreased motility, absorption, reflux, abdominal pain, vomiting, cramping
  - Reduced risk of colon cancer, inflammatory bowel disease
- Increased fibrinolytic activity
- Slowing of coagulation
- Immune system increased with regular exercise
- Strenuous exercise temporarily depresses immune system and mucosal immunity

when you are sick if lightly so, do a mild workout and you might help yourself. bad sick and do workout actually decreases your get sicker.
PSYCHOLOGICAL BENEFITS

- Increased energy
- Increased motivation
- Positive self-image
- Increased self-esteem
- Decreased anxiety
- Improved mood
- Better stress management
ASSESSMENT OF ACTIVITY TOLERANCE

- Perceived level of activity
- Level of fatigue
- Ergometry (bicycle, treadmill)
  - Target heart rate: 220-age
- Metabolic equivalents (METs): one MET is equal to the energy expended in a resting position

*estimates of energy expenditure, but that changes from person to person.*
Fatigue: not having sufficient energy stores to endure desired activities

- Normal in strenuous exercise
- Abnormal in cardiac or respiratory disease, anemia
- From mental stress of lack of sleep
- Persists despite adequate sleep
FATIGUE

- Environmental:
  - Temperature extremes
  - Weather changes
  - Noise

- Medications
  - Tranquilizers
  - Alcohol

- Treatments
  - Chemotherapy
  - Anesthesia

- Physical exertion
- Psychological factors
  - Stress
  - Depression

- Can be acute (<4 weeks) or chronic (more than 1 month)
FATIGUE

- Acute fatigue: usually due to exertion
  - Occurs more quickly in deconditioned muscles

- Chronic fatigue: insidious onset, not relieved by rest and usually perceived as more intense compared to the amount of activity
  - May interfere with work, quality of life
FATIGUE

- Occurs in many diseases:
  - Cancer
  - Cardiac disease
  - Renal disease
  - Chronic lung disease
  - Hepatitis C

- HIV/AIDS
- Multiple sclerosis
- Parkinson’s
- Anemia
- Insomnia

sometimes that's the only symptom... due to low RBCs/oxygen
CHRONIC FATIGUE SYNDROME

- Disabling fatigue of at least 6 months’ duration
- Associated with trouble thinking, sleep disturbances, musculoskeletal pain
- Overlaps with fibromyalgia, depression, irritable bowel syndrome

might meet the criteria of CFS, but can be caused by other stuff like bullet point 3.
CHRONIC FATIGUE SYNDROME

Uncertain etiology: hard to nail down...

+ Infectious: viral, Lyme disease, candida? these problems usually resolve, may go chronic....?
+ Psychological: cause or effect?
+ Immune system dysfunction: many patients report symptoms beginning after an illness
  - Abnormal NK cell activity? has it turned into an autoimmune problem?
+ CNS abnormality: brain stem vs. hypothalmic/pituitary/adrenal is it hormonal in the brainstem, pituitary,
+ Autonomic nervous system dysfunction
CHRONIC FATIGUE SYNDROME

- Associated symptoms:
  - Flu-like illness at onset
  - Recurring symptoms
  - Low-grade fever
  - Pharyngitis (nonspecific sore throat)
  - Tender cervical lymph nodes
  - Mild thyromegaly
  - Wheezing
  - Headaches

- Splenomegaly
- Myalgias
- Polyarthralgias (multiple joint aches)
- Heme-positive stool
- Impaired cognition
- Mood disorders
- Sleep disruption
- Visual disturbances
- Anxiety & depression
- Postexertional malaise (feel a lot more tired after exercise than before they had)
Gravity produces skeletal muscle contraction, which pumps blood through veins. Weight bearing strengthens bones.

For most conditions, early remobilization is better than prolonged rest and inactivity true of many injuries including heart attack and back injuries.
BED REST AND INACTIVITY

- Cardiovascular effects: redistribution of blood volume more centrally, heart deconditioning, increased heart rate, orthostatic hypotension
  - Can take 5-10 weeks to resume normal cardiac output

- Orthostatic hypotension: When standing after bed rest, blood moves back to the lower extremities resulting in decreased cardiac output.
  - Autonomic dysfunction
  - Dizziness, tachycardia, fainting happens more often in elderly people.
BED REST AND INACTIVITY

- Venous stasis with increased risk of DVT:
  - Redistribution of blood volume centrally, leading to increased viscosity peripherally
  - Lack of skeletal muscle pump
  - Exterior pressure from mattress
  - Other risk factors: birth control, hypercoagulable state

if you're driving a long way and you're on birth control (esp if you smoke), get out and walk every hour!!!

going on a long flight? take an aspirin daily for a couple of days before the flight.
**BED REST AND INACTIVITY**

- **Pulmonary effects:**
  + Decreased lung capacity
  + Must work harder to breathe and take fewer deep breaths resulting in atelectasis, accumulation of secretions, hypoxemia, pulmonary emboli

- **Urinary tract effects:** decrease in urine clearance from the kidney
  + Increased risk of stones, infections
  + Worse with dehydration
  + Increased incontinence due to decreased emptying of the bladder and overfill stresses the bladder muscles.
Musculoskeletal effects: disuse atrophy with 1/8 of muscle’s strength lost each week

- Loss of lean muscle
- Fast twitch fibers decline faster than slow-twitch
- The larger and stronger the muscle, the faster strength is lost
  
- Overall shortening of muscles, the most severe of which are contractures
  
  - Develop when there is an imbalance in muscle groups

  like when you get a stroke patient with drawn up wrists - one side really shortens, one side really lengthens
BED REST AND INACTIVITY

- Loss of bone, development of osteoporosis
  - Osteoblasts function less without weight bearing but osteoclasts continue function
  - Increased calcium & phosphorus excretion also contributing to kidney stones

- Skin: pressure sores due to impairment of normal blood flow leading to ischemia and necrosis
BED REST AND INACTIVITY

- Decreased basal metabolic rate
- Slowed anabolic processes
- Increased catabolic processes
- Protein breakdown and negative nitrogen balance
- Glucose intolerance and hyperinsulinemia
- Increased parathyroid hormone which contributes to increased calcium levels and even more risk for kidney stones.
**BED REST AND INACTIVITY**

- Immune system changes with increased risk of infection
- GI effects:
  - Decreased appetite, slowed absorption
  - Constipation and impaction
  - Muscle atrophy in both muscles and GI tract.
- Impaired sensory responses:
  - Visual and auditory hallucinations
  - Vivid dreams
  - Decreased thought processes
  - Altered tactile stimulation
  - Loss of contact with reality
BED REST AND INACTIVITY

Psychosocial responses:
- Depression
- Anxiety
- Fear
- Hostility
- Abnormal sleep patterns
- Decreased ability to learn and problem solve
Define metabolism, calorie
+ Most of energy stored in fat
+ White fat vs brown fat

Anabolism vs catabolism

Liver regulates glucose
+ Brain & nerves use glucose for fuel
+ Glycogenolysis vs gluconeogenesis

Fats have more energy than sugar
+ Ketones are byproduct, used by brain
  if no glucose, can use ketones.
BMR comprises 50-70% of energy needs

Fat vs water soluble vitamins

Types of obesity, BMI, waist to hip ratio and waist circumference

Treatment goals

Types of malnutrition

Effects of protein-calorie malnutrition
REVIEW

- Define female athlete triad
- Characteristics of anorexia, bulimia, binge eating disorder
- Benefits of exercise
- Anaerobic vs aerobic exercise
- Four components of exercise
- Cardiopulmonary, neuromuscular and skeletal muscle changes, systemic effects
REVIEW

- Acute vs chronic fatigue
- Causes of fatigue
- Chronic fatigue syndrome: diagnostic criteria, associated syndromes and symptoms
- Effects of bed rest and inactivity
  + Early remobilization almost always best