

Energy Balance & Body Weight



- *Overweight* and *obesity* are characterized by excessive body fat.
 - Most common nutritional disorders in the U.S.
- In 2003-2004:
 - 2/3 of American adults were overweight or obese.
 - Increasing among infants and children

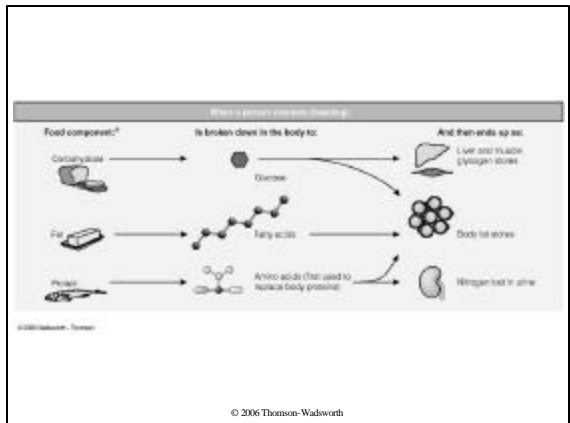
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Energy Balance

- Calories in = calories out
- Calories in > calories out
 - Weight gain
- Calories in < calories out
 - Weight loss



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Energy Balance

- Fat is stored in adipose tissue
- 1 pound of body fat = 3500 calories

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Energy Needed For:

- Basal Metabolic Rate (BMR)
 - Breathing, new tissue, circulation
 - Regulated by thyroid hormone (thyroxine)
 - 50 to 60% of energy needs

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TABLE 9-3 FACTORS THAT AFFECT THE BMR	
Factor	Effect on BMR
Age	The BMR is higher in youth; as lean body mass declines with age, the BMR slows. Continued physical activity may prevent some of this decline.
Height	Tall people have a larger surface area, so their BMRs are higher.
Growth	Children and pregnant women have higher BMRs.
Body composition	The more lean tissue, the higher the BMR. A typical man has greater lean body mass than a typical woman, making his BMR higher.
Fever	Fever raises the BMR.
Stress	Stress hormones raise the BMR.
Environmental temperature	Adjusting to either heat or cold raises the BMR.
Fasting/starvation	Fasting/starvation hormones lower the BMR.
Malnutrition	Malnutrition lowers the BMR.
Thyroxine	The thyroid hormone thyroxine is a key BMR regulator; the more thyroxine produced, the higher the BMR.

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Energy Needed For:

- Dietary Thermogenesis / Thermic Effect of Food
 - Digestion and absorption
 - 5 to 10% of energy needs

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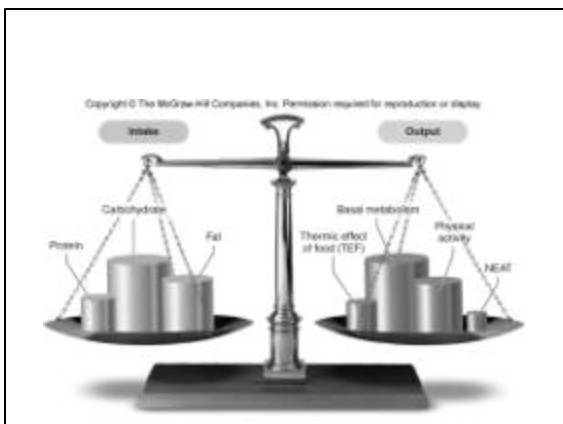
Energy Needed For:

- Voluntary Activities / Exercise
 - Any physical activity
 - 25 to 50% of energy needs
 - Fidgeters burn more calories
 - Best way to increase calorie expenditure is exercise!

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- Basal Metabolism
- Physical Activity
- Thermic Effect of Food (TEF)
- Nonexercise Activity Thermogenesis (NEAT)

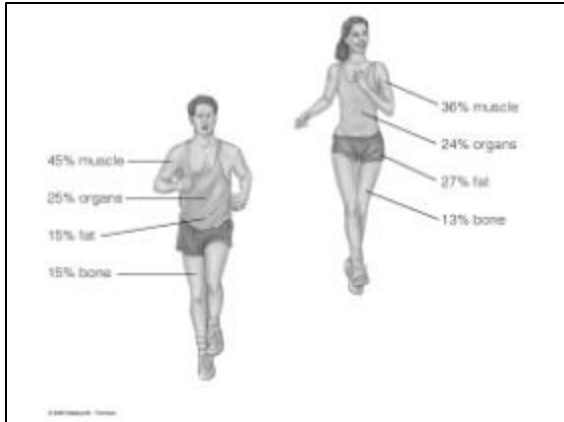
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Body Composition

- Proportion of muscle, fat, bone
- Women: more fat, less muscle
- Men: more muscle, less fat
- Weight and height can't tell us about body composition

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Body Composition

- Body Mass Index (BMI)
 - Correlated with body fatness

$$\text{BMI} = \text{weight (kg)} \div \text{height (m)}^2$$

or

$$\text{BMI} = \text{weight (lb)} \div \text{height (in)}^2 \times 703$$

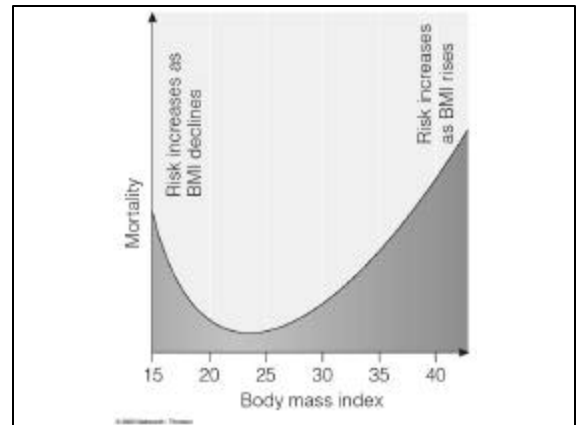
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Body Mass Index (BMI)

- <18.5 is underweight
- 18.5 to 24.9 is healthy range
- 25 to 29.9 is overweight
- >30 is obese

- Centers for Disease Control (CDC)

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Body Composition

- Limits of BMI
 - Is weight muscle or fat?
 - Cannot be used in pregnancy
 - Overestimates obesity in very muscular
 - Underestimates obesity in very fat

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Body Mass Index

Two photographs illustrating limitations of BMI:

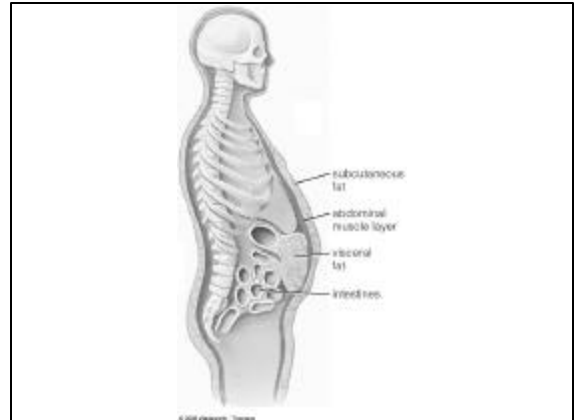
- The top photograph shows a muscular football player, illustrating that high muscle mass can lead to a high BMI despite low body fat.
- The bottom photograph shows an elderly couple, illustrating that high body fat can lead to a high BMI despite low muscle mass.

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Body Composition

- Central or Visceral Obesity
 - Apple vs pear shape
 - More weight carried around abdomen = increased risk of:
 - Type 2 diabetes
 - Stroke
 - Hypertension
 - Coronary artery disease / heart disease

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Central Obesity

- Increased risk of disease if:
 - Waist Circumference
 - Men: Greater than 40 inches
 - Women: Greater than 35 inches
 - Waist to Hip Ratio
 - Men: Greater than 0.9
 - Women: Greater than 0.8
 - NOTE: If you don't have excess body fat, this ratio is not applicable

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Body Composition

- Anthropometry
 - Skinfolds, fatfolds
 - Measure fat deposition under skin
 - Waist circumference
 - Waist to Hip Ratio



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Body Composition

- Bioelectrical Impedance
 - Electrical conductivity
 - Lean (muscle) tissue conducts better than fat
 - Not always accurate



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Body Composition

- Underwater weighing
 - Weight compared to volume
 - Fat less dense than muscle (fat weighs less per volume)



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Body Composition

DEXA (dual energy
xray
absorptiometry)

- Research, medical settings
- Also used to measure bone density



Dual energy X-ray absorptiometry (DEXA) employs two low-dose X-rays that differentiate among fat-free soft tissue (lean body mass), fat tissue, and bone tissue, providing a precise measurement of total fat and its distribution in all but extremely obese subjects.

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Rising Rates of Obesity

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Risks of Obesity

- Hypertension
- Type 2 diabetes (triples)
- Heart disease
- Some cancers (colon, gall bladder, prostate, breast)
- Sleep apnea
- Asthma
- Arthritis and other joint problems

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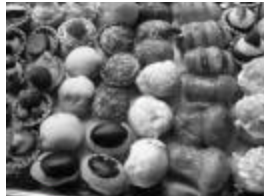
Risks of Obesity

- Pregnancy complications
 - Hypertension
 - Gestational diabetes
 - Birth defects
- Prejudice
- Poor self esteem, depression (especially children)

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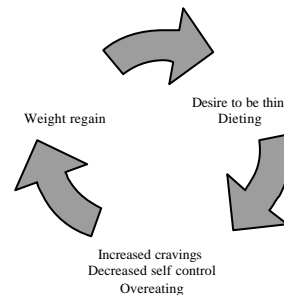
Risks of Dieting

- 95% regain weight within 5 years
 - Doesn't work
- "Yo-Yo" dieting
- More disordered eating
- Decreased BMR
- Increased preoccupation with food



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Unhealthy Diet Cycle



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Fit and Fat



- Cardiovascular fitness improves health, regardless of BMI
- Even 10% weight loss can improve health
- "Metabolic fitness"

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Hunger

- Physical sensation
- Physiologic need for food
- Symptoms
 - Stomach pain
 - Headache
 - Irritability
 - Others?



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Appetite

- Psychological desire to eat
- Can happen without physical hunger



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Satiety

- Protein may be most satiating
 - Popularity of high-protein weight-loss diets
- Protein and fat slow stomach emptying and prolong fullness
- Fiber
- Water



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Orexins — peptides (*hypothalamus*) that may contribute to hunger

Ghrelin — hormone (*stomach*) stimulates eating behavior

Leptin — hormone (*adipose cells*) reduces hunger and inhibits fat storage



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Leptin-producing mouse vs. Mouse that doesn't produce leptin

Causes of Obesity

- Genetic / Physiological
- Environmental
- Socioeconomic
- Psychological



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Causes of Obesity

- Genetics:
 - Metabolic rate
 - **“thrifty metabolism”**
 - Hormone production
 - Body frame size
 - Pattern of fat distribution
- Children with one obese parent have a 40%- 70% chance of becoming obese

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Causes of Obesity

- “Obesogenic” environment
 - Society discourages activity
 - Technology discourages activity
 - Food everywhere
 - Large portions
 - More eating out and take out
 - Less home cooking

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Causes of Obesity

- “Screen time”
- Food marketing
- Dieting
- Unrealistic expectations about size and weight
- Emotional eating
- Mindless eating
- Less physical work
- Less physical activity



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Successful Long-Term Weight Management

1. Motivation
2. Calorie reduction
3. Regular physical activity
4. Behavior modification

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Popular diets

- Low-Carbohydrate Diet
 - Short term weight loss
 - Increased water loss with N excretion
 - Decreased food and calories
 - Over a year = weight regain
 - As carbohydrate runs low the body breaks down fat and protein for energy and ketones form to feed the brain

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Popular diets

- Low-Carbohydrate Diet
 - Usually high in saturated fat
 - Low fiber, low phytochemical
 - High protein strains kidneys
 - Increased calcium losses

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Beware of diets that:

- ✓ Offer “quick fix” rapid weight loss
- ✓ Severely limit food choices
- ✓ Require buying a book or various gimmicks, such as supplements, patches, or creams
- ✓ Use outrageous and unscientific claims
- ✓ Rely on testimonials of famous people
- ✓ Do not emphasize changing eating habits and physical activity

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To Manage Weight

- Set goals that are
 - Specific
 - Attainable
 - Forgiving
- Find **enjoyable** activity
- Keep food and exercise records
- Plan for food and exercise



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To Manage Weight

- Reward yourself, but not with food
- Plan for relapses
- Enjoy food
- Listen to hunger and satiety
- Get support



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Dietary Strategies

- Replace low-fiber foods with high fiber
- Add fruit and vegetables
- Drink a reasonable amount of water
- Cut back on or eliminate alcohol
- Serve smaller portions
- Avoid skipping meals or getting too hungry

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Weight-Loss Medications

Sibutramine (Meridia)

- Alters brain chemistry, delaying hunger
- **Side effects**: constipation, dry mouth, sleep disturbances, increased blood pressure

Orlistat (Xenical and Alli)

- Reduces fat digestion by ~30%
- **Side effects**: oily feces, less fat-soluble vitamin absorption

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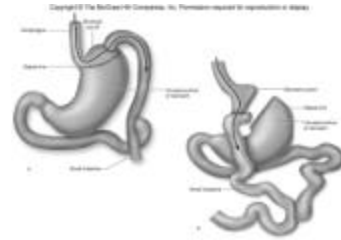
Bariatric Surgery

- **For extreme obesity** (BMI =40; BMI =35 with coexisting disease)
 - *Reduces size of stomach, limiting food intake*
- Can achieve normal blood pressure, glucose, and triglyceride levels
- Complications: intestinal blockage and bleeding, ulcer or blood clot formation.
 - *Death in 1% of patients*

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Gastric Bypass

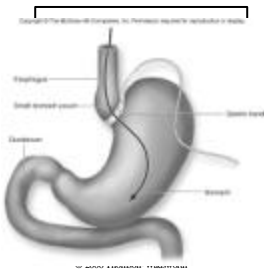
- Small intestine is cut with lower end attached to the newly formed stomach pouch



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Adjustable Gastric Banding

- Stomach pouch created with adjustable band



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What Is Liposuction?

- Surgical method suctioning fat out of the body
 - *Cosmetic procedure*
 - *Not treatment for obesity*



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