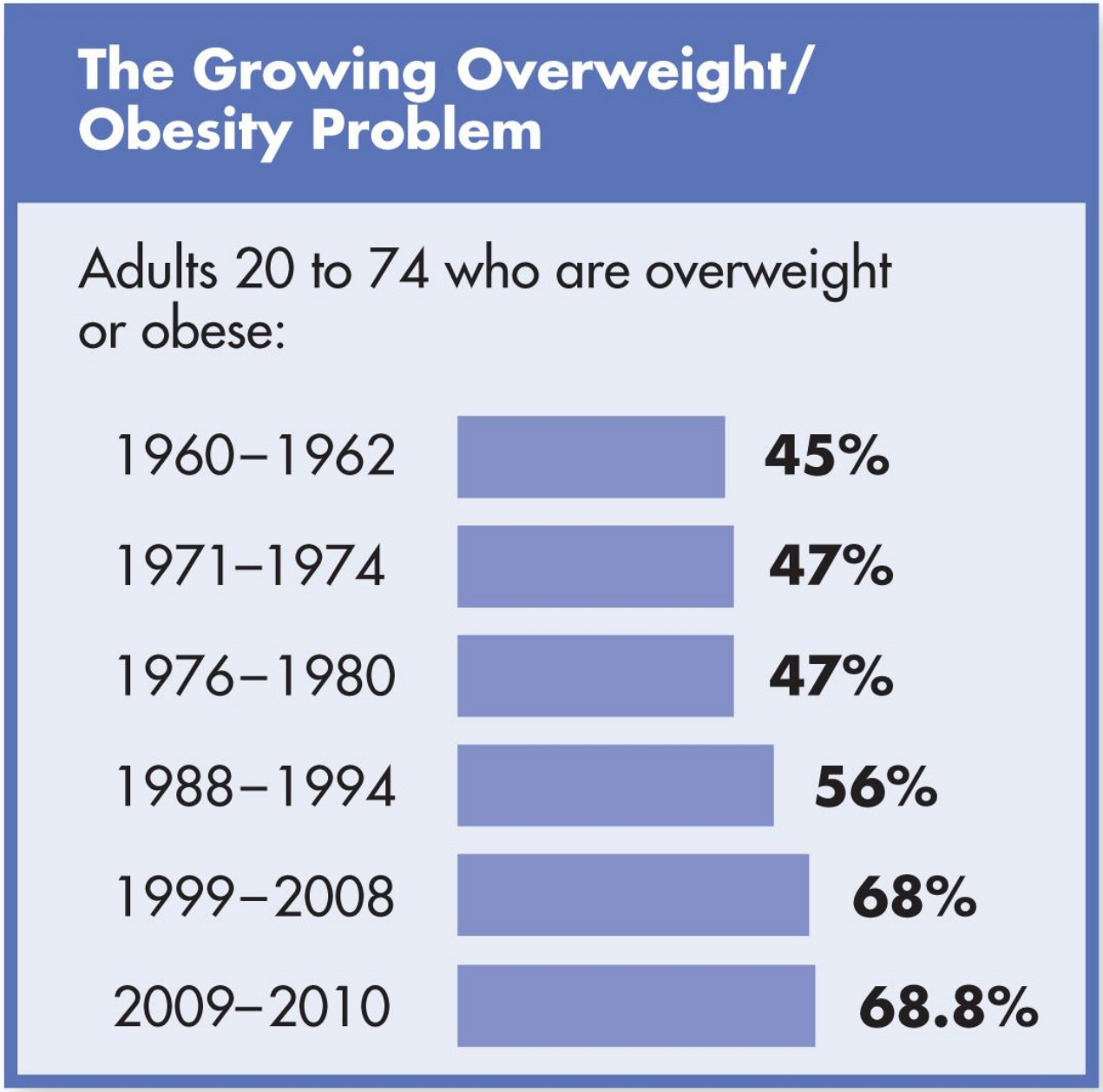
Energy Balance
Weight Control
Disordered Eating

Student Learning Outcomes

- Describe energy balance and its relationship to energy intake and expenditure.
- Evaluate the different methods used to measure energy expenditure by the body.
- Explain internal and external regulation of hunger, appetite, and satiety.
- Describe the methods used for assessing body composition.
- Explain the impact of genetics and environment on body weight and composition.
- Describe and evaluate the key components of programs designed to treat overweight and obesity.
- Describe the symptoms, health effects, and treatment of different eating disorders.

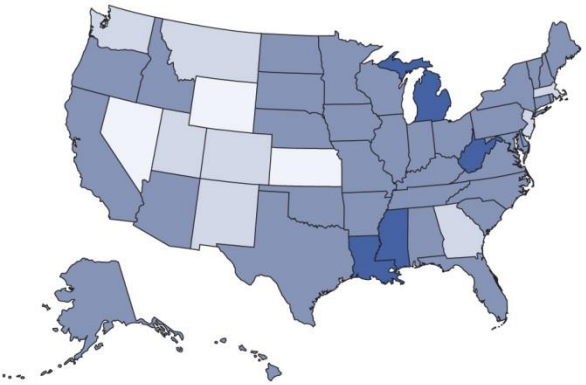
Energy Balance and Weight Control

- 1 billion people worldwide are overweight or obese
  - 68.8% of North American adults are overweight
  - 34% of total population is obese
- High-fat, high-sugar increasing in popularity
- Excess weight increases likelihood of many health problems
- Government agencies, food industry, health professionals, communities, addressing weight problem in North America



Obesity Trends in the U.S.

Obesity Trends* Among U.S. Adults
BRFSS, 1991
(*BMI ≥30, or ~ 30 lbs. overweight for 5′ 4″ person)



Obesity Trends* Among U.S. Adults
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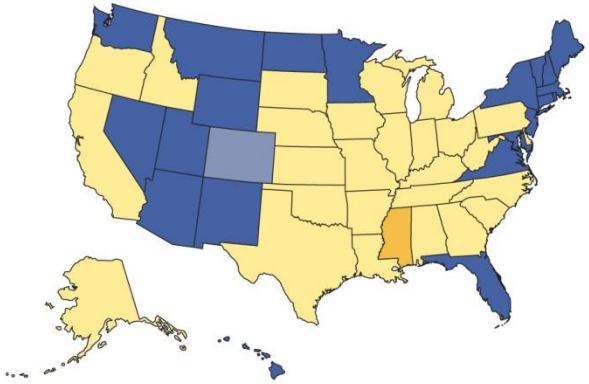
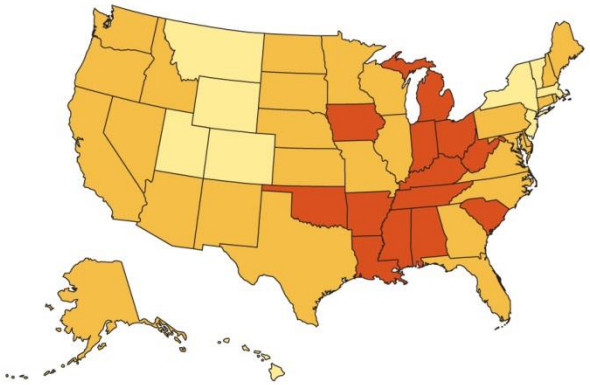


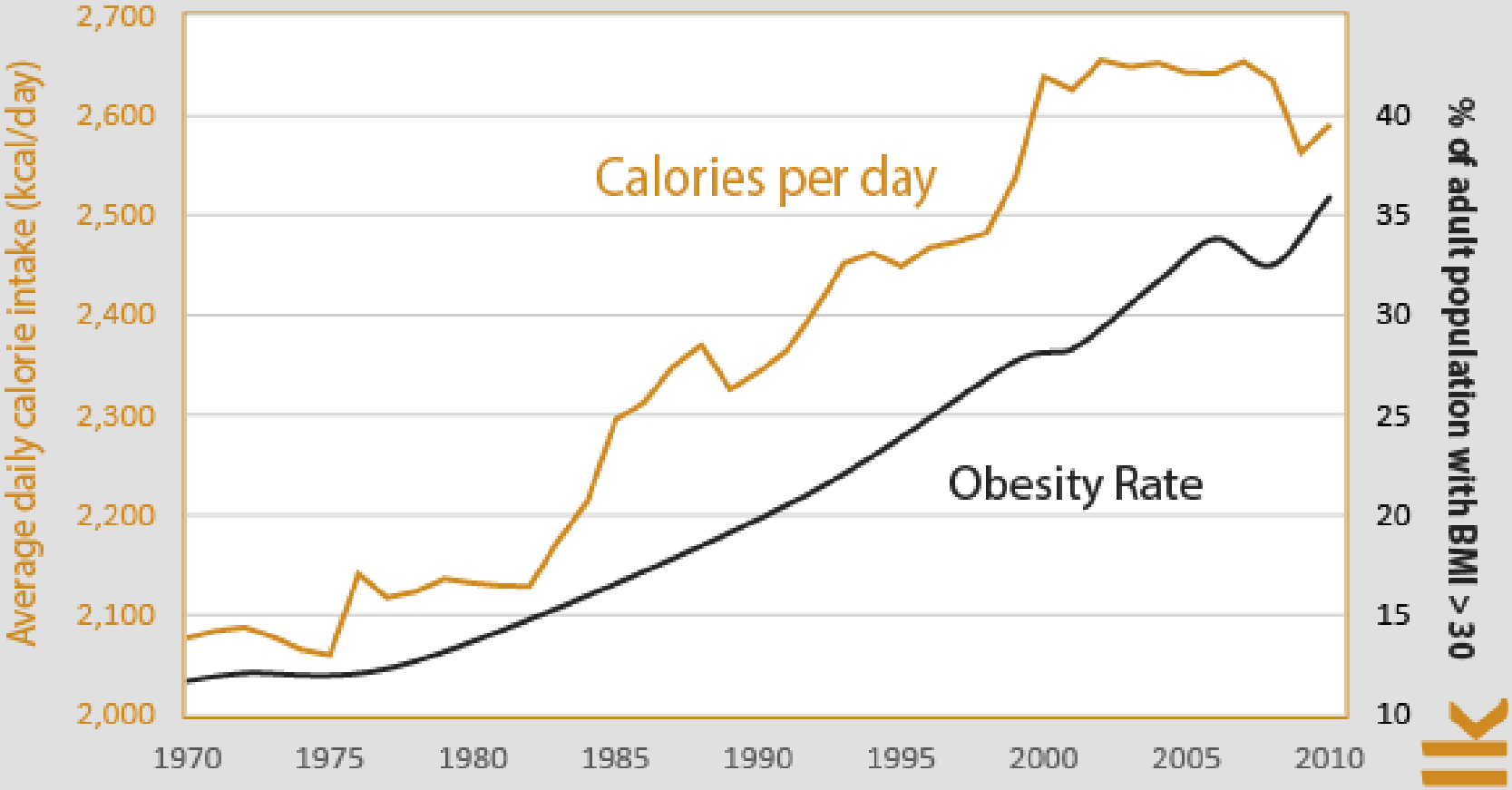
Prevalence* of Self-Reported Obesity Among U.S. Adults**
BRFSS, 2012
*prevalence reflects BRFSS methodological changes in 2011, and these estimates should not be compared to those before 2011. (**BMI ≥30, or ~ 30 lbs. overweight for 5′ 4″ person)



No data | <10% | 10%–14% | 15%–19% | 20%–24% | 25%–29% | 30%–<35% | ≥35%

(all): CDC BRFSS

America: Obesity Rate vs Caloric Intake



Data: US Department of Agriculture Economic Research (Calories), NHANES surveys (Obesity rates)

Credit: original graph concept from Stephan Guyenet.

Learn more: http://fitfolk.com/fat-loss-framework/

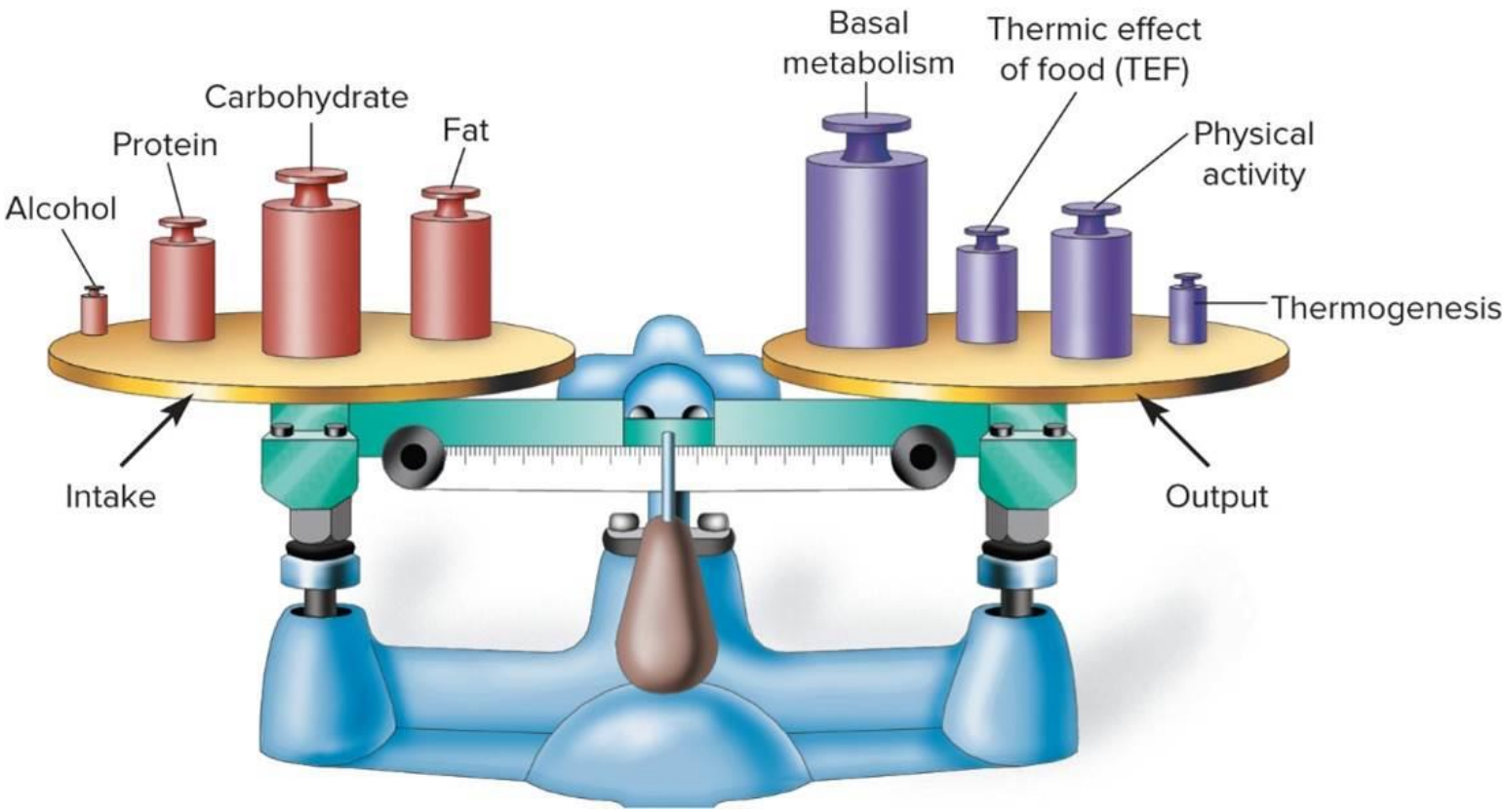
fitfolk

Energy Intake

- Energy needs met by food intake
  - represented by number of calories eaten each day
- Average adult is 8 pounds heavier than just 10 years ago
  - Why?

- Cheap cost
- Availability of palatable food in vending machines
- Drive-up windows
- Social gatherings
- *Supersized* portions
- Physical inactivity
- High glycemic foods
- Sugar and refined grains dominating the food supply

Energy Intake and Expenditure



Jump to long description

Energy balance

Energy intake = energy expended

Positive energy balance

Energy intake > than energy expended

Results in weight gain

Negative energy balance

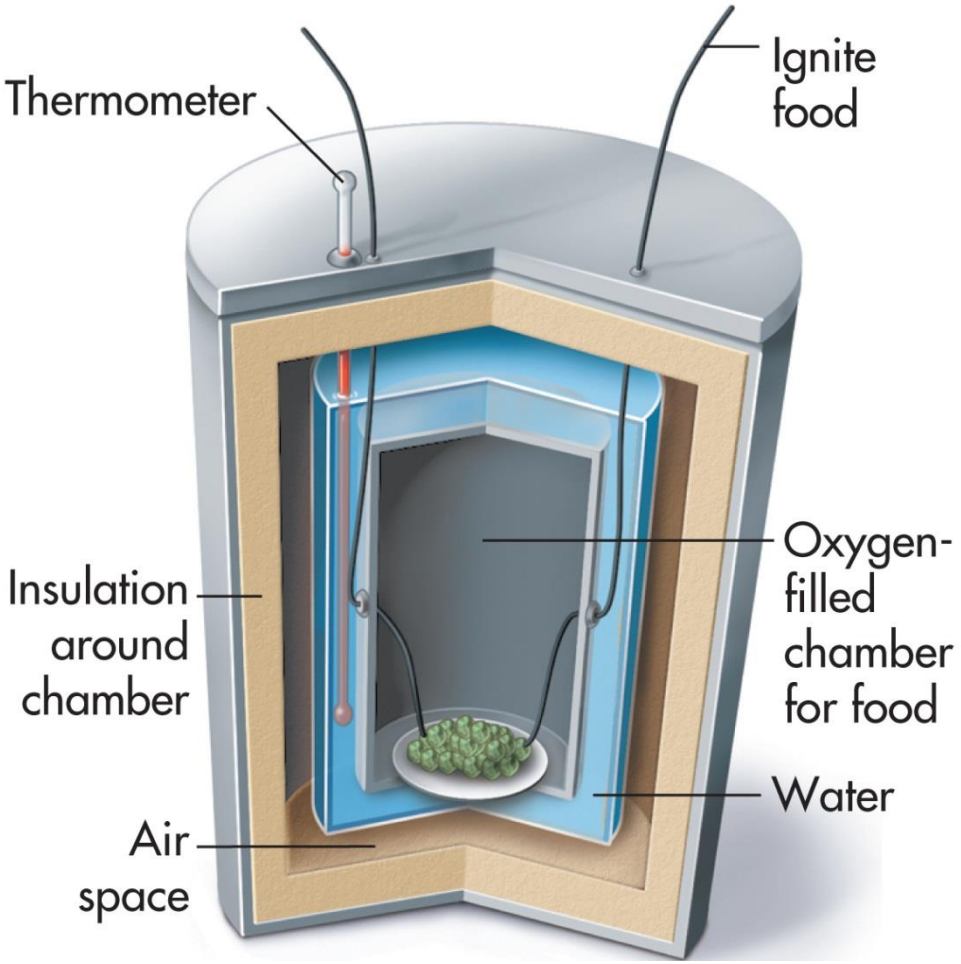
Energy intake < energy expended

Results in weight loss

1 lb. weight loss = 3300 kcal

Using 3500 kcal is more simple to use

Estimating kcal Content in Food

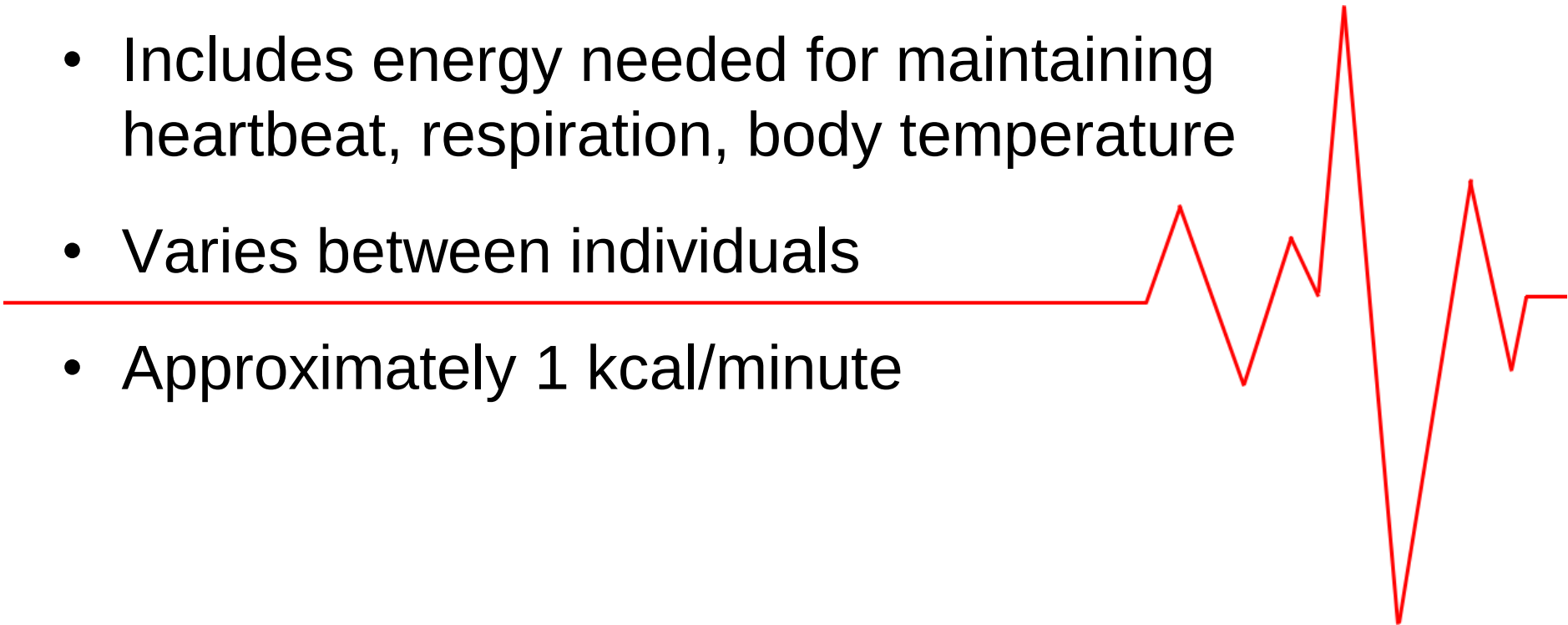


Bomb Calorimeter

- measures calorie content by burning dried portion of food. Burning food raises temperature of water surrounding chamber holding food

Basal Metabolism

- Minimal amount of calories body uses to support itself in a fasting state when resting and awake in warm, quiet environment
  - ~60-75% of total energy needs
- Includes energy needed for maintaining heartbeat, respiration, body temperature
- Varies between individuals
- Approximately 1 kcal/minute

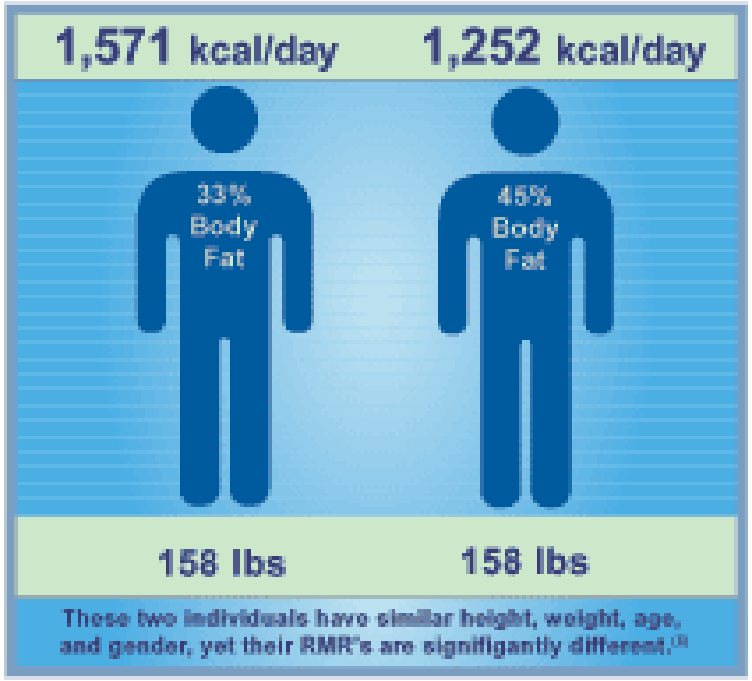


What Factors Affect Metabolic Rate?

Metabolic Rate

Factors That Influence Metabolism

- Body surface area (weight, height)
- Lean body mass
- Gender
- Body temperature
- Thyroid hormone
- Stress, norepinephrine
- Age
- Calorie intake
- Pregnancy
- Use of caffeine and tobacco

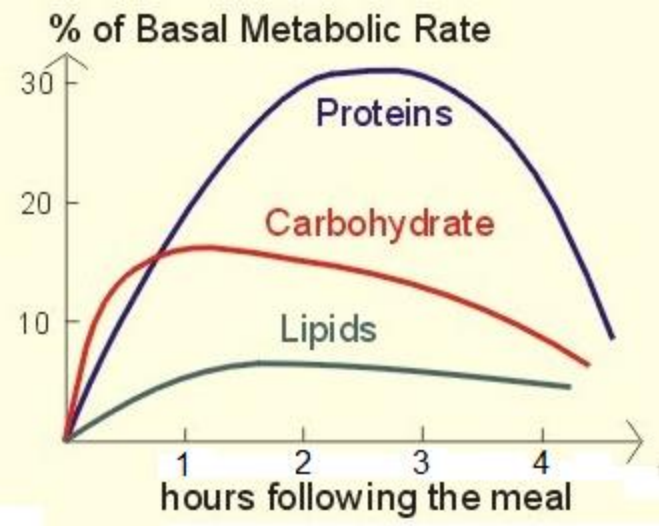


Physical Activity

- Physical activity: Increases energy expenditure, by as much as 15% to 35%
  - During activity
  - After activity
  - Building muscle (lean body mass)

Thermic Effect of Food

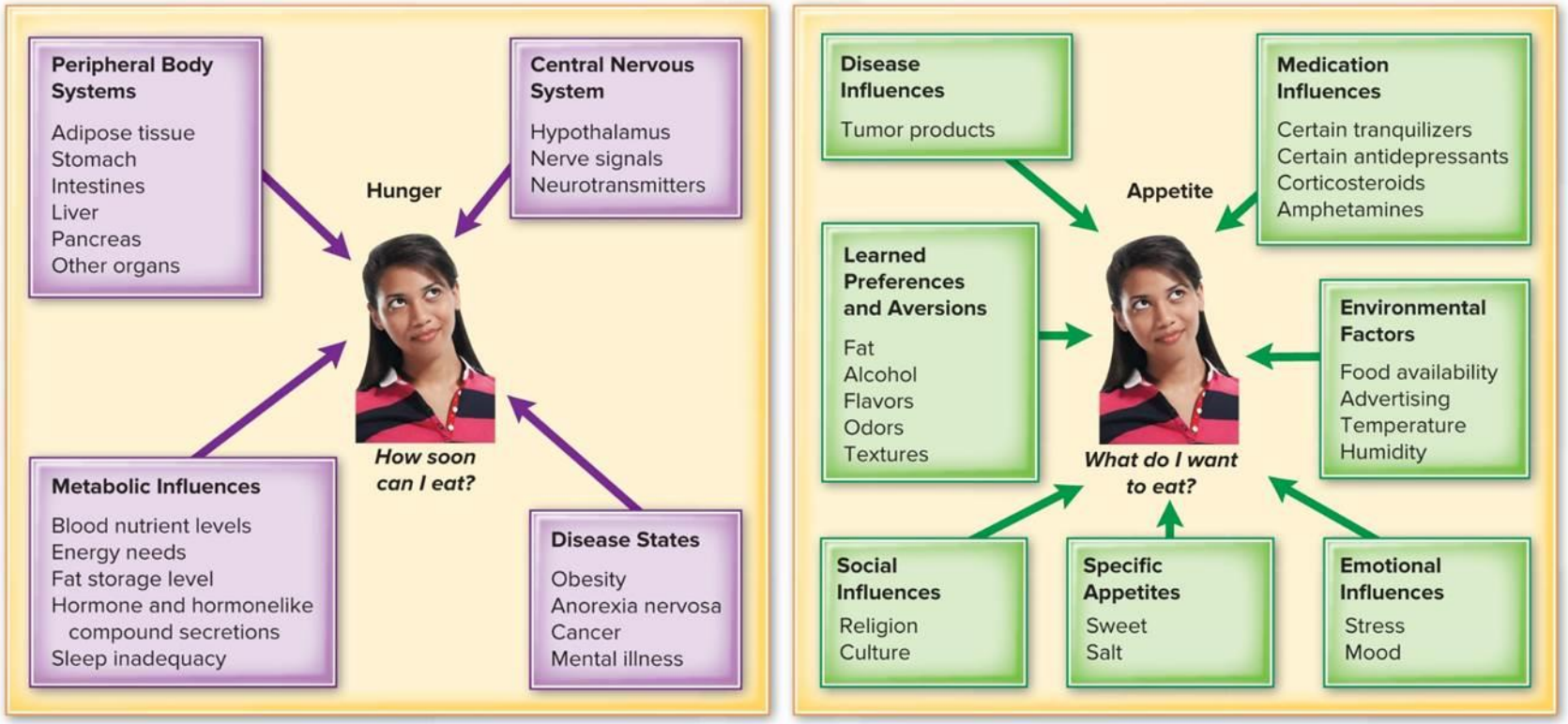
- Energy used to digest, absorb, and metabolize food nutrients
  - ~5-10% above the total calories consumed
  - Highest for protein, then carbohydrate, then fat



Adaptive Thermogenesis

- Nonvoluntary physical activity
  - Triggered by overeating
    - Increases sympathetic nervous system activity
  - Includes: fidgeting and shivering, maintenance of muscle tone, maintenance of posture
  - Resists weight gain
  - Brown Adipose Tissue
    - Participates in thermogenesis

Factors That Impact Hunger and Appetite



Jump to long description

Eating Behavior Regulation

Hunger and appetite drive our desire to eat.

Hunger

- Physiological drive to find and eat food
- Controlled by internal mechanisms such as organs, hormones, hormonelike factors, nervous system

Appetite

- Psychological drive to eat
- Affected by external factors such as social custom, time of day, mood, memories, sight

Eating Behavior Regulation

Although internal and external signals operate simultaneously to lead us to decide whether to reject or eat food, we can override these signals

- Eating dessert on a full stomach
- Ignoring hunger because we have no appetite for food being served

Fulfilling these drives brings us to a state of satiety

- We are satisfied and no longer have the drive to eat
- Hypothalamus is the site for regulation

Eating Behavior Regulation

Hypothalamus

- Communicates with endocrine and nervous system
- Integrates internal cues of blood glucose levels, hormone secretions, and sympathetic nervous system

If internal signals stimulate the satiety center, we stop eating; if they stimulate feeding centers, we eat more.

Energy for Physical Activity

Physical activity increases energy expenditure above basal needs by **25 to 40%.**

Being active or inactive determines much of our total energy expenditure

- Climb stairs rather than take elevator
- Walk rather than drive
- Stand in a bus rather than sit

The increased rate of obesity in North America is caused in part by our inactivity.

Measuring Energy Expenditure

Energy used by the body can be measured by:

- Direct calorimetry
- Indirect calorimetry

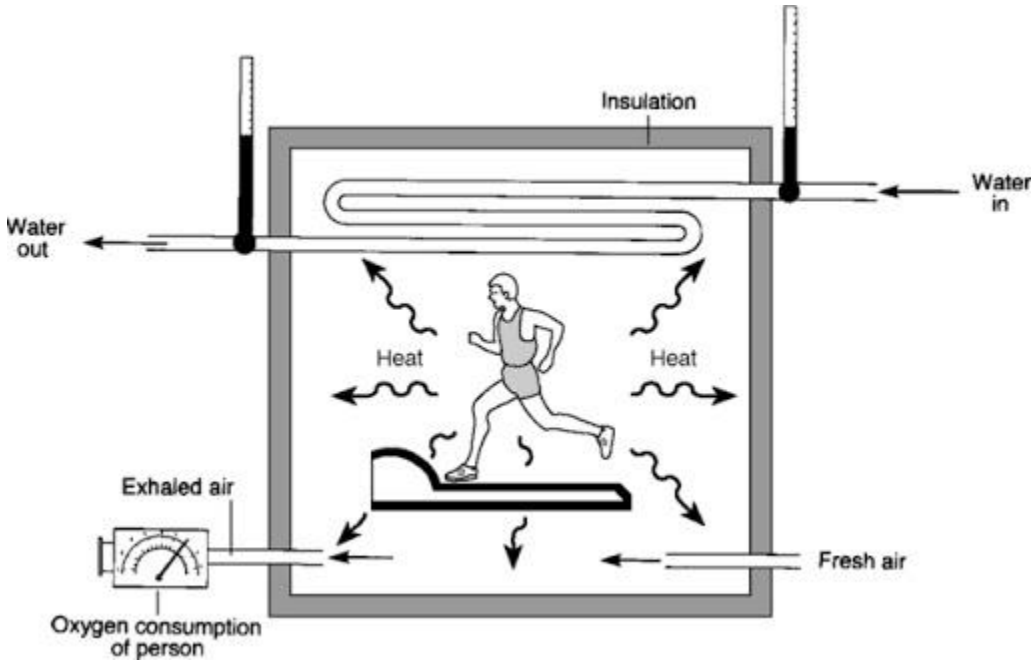
Energy used can be estimated based on:

- Height
- Weight
- Physical activity
- Age

Measuring Energy Expenditure

Direct calorimetry

- Estimates energy expenditure by measuring amount of heat released by the body
  - About 60% of energy the body uses leaves as heat
- Heat release is measured by placing person in insulated chamber surrounded by layer of water
  - Change in temperature determines amount of energy person expended



Measuring Energy Expenditure

Indirect calorimetry

- Involves collecting expired air
  - Predictable relationship between body's use of energy and amount of oxygen consumed and carbon dioxide produced
- Data tables can show energy costs of different exercises

©Samuel Ashfield/SPL/Science Source

Estimates of Energy Needs

EER for Men 19 years and older:

EER= 662-(9.53 x AGE) + PA x (15.91 x WT + 539.6 x HT)

EER for Women 19 years and older:

EER= 354- (6.91 x AGE) + PA x (9.36 x WT + 726 x HT)

EER = Estimated Energy Requirement **AGE** = age in years

PA = Physical Activity Estimate (see following table)

WT = weight in kilograms (pounds ÷ 2.2)

HT = height in meters (inches ÷ 39.4)

Physical Activity (PA) Estimates

Activity Level	PA (Men)	PA (Women)
Sedentary (e.g., no exercise)	1.00	1.00
Low activity (e.g., walks the equivalent of 2 miles per day at 3 to 4 mph)	1.11	1.12
Active (e.g., walks the equivalent of 7 miles per day at 3 to 4 mph)	1.25	1.27
Very active (e.g., walks the equivalent of 17 miles per day at 3 to 4 mph)	1.48	1.45

States of Energy Balance

Jump to long description

What is defined as a healthy body weight?

Body Mass Index (BMI)

Body mass index is calculated as:

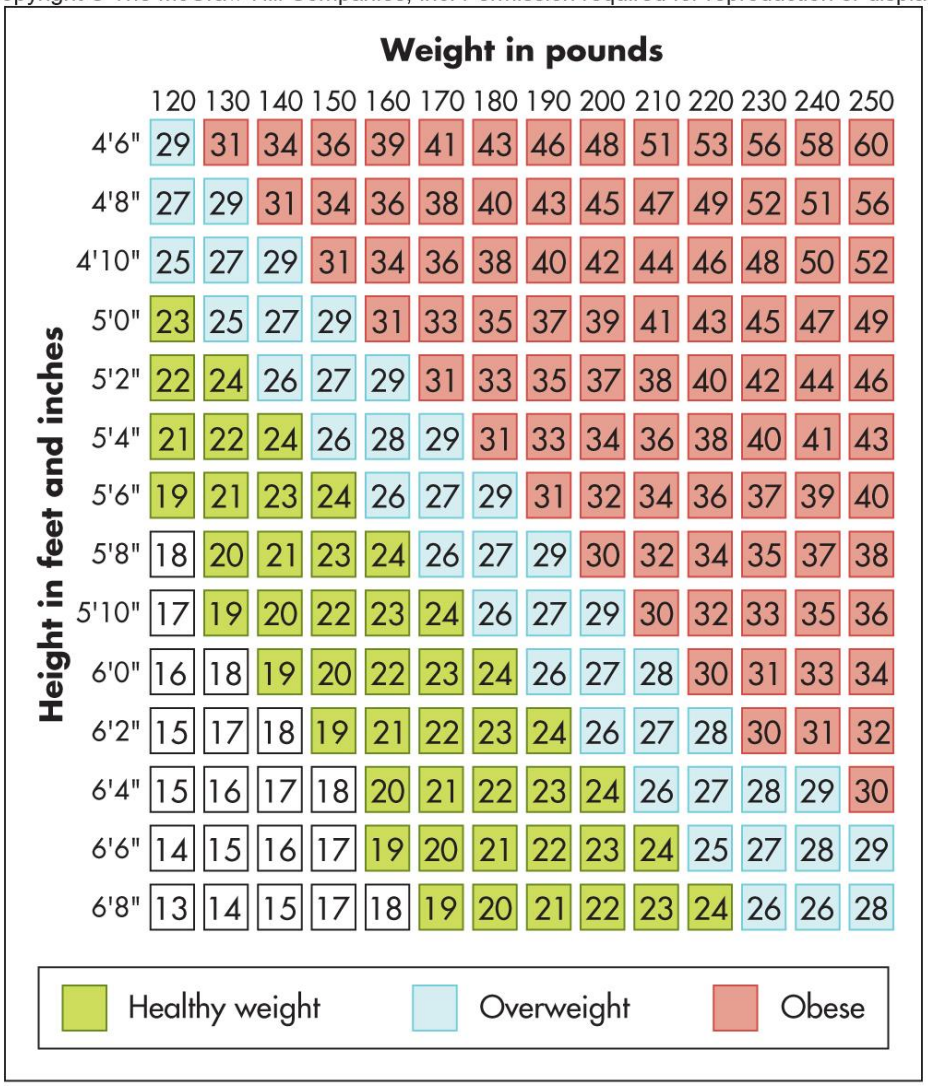
$$\frac{\text{body weight (in kilograms)}}{\text{height}^2 \text{ (in meters)}}$$

Or

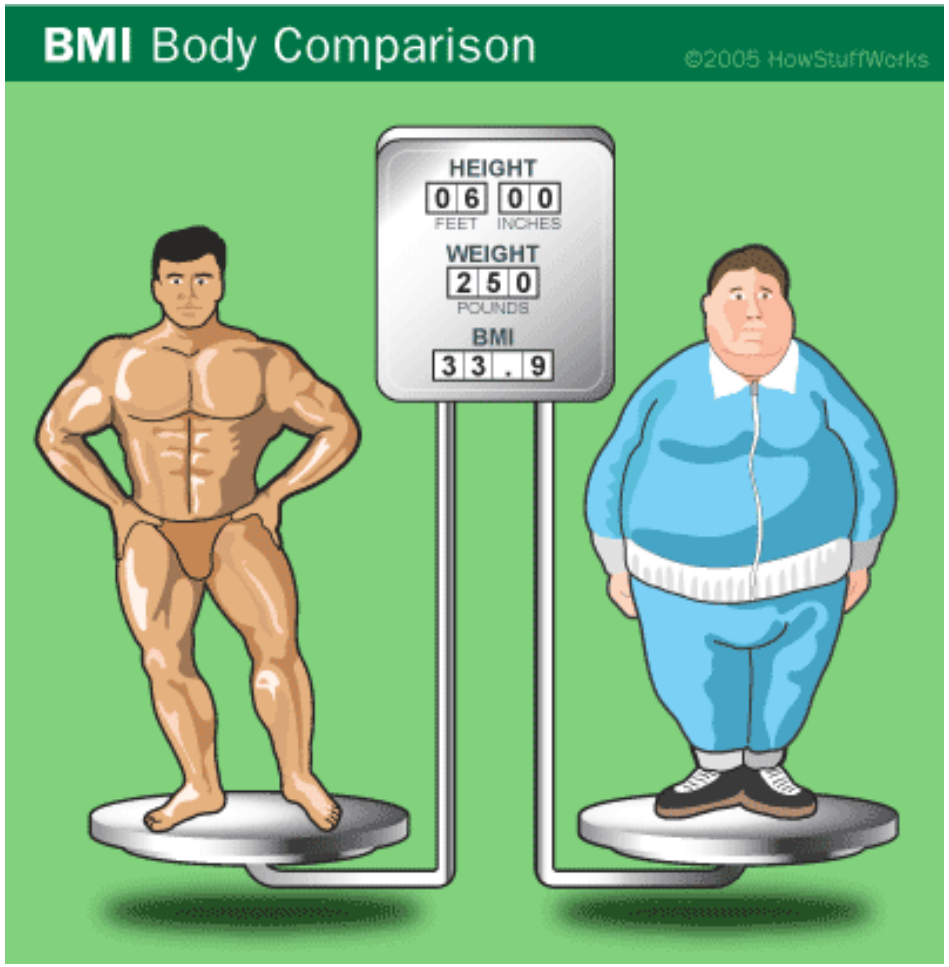
$$\frac{\text{weight (pounds) X 703}}{\text{height}^2 \text{ (inches)}}$$

Category	BMI
Underweight	<18.5
Healthy weight	18.5–24.9
Overweight	25–29.9
Obese	30–39.9
Morbidly obese	>40

Height / Weight Table



Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion



Lean mass can vary between individuals of the same weight

What Is a Healthy Body Weight?

- Current height/weight standards
  - Weight associated with health and longevity
  - May not be the healthiest weight for individual
  - Do not take into account lean mass (muscle)
- Should be determined with medical professional with consideration for:
  - Personal and family weight history, fat distribution patterns, family history of weight-related disease, current health status

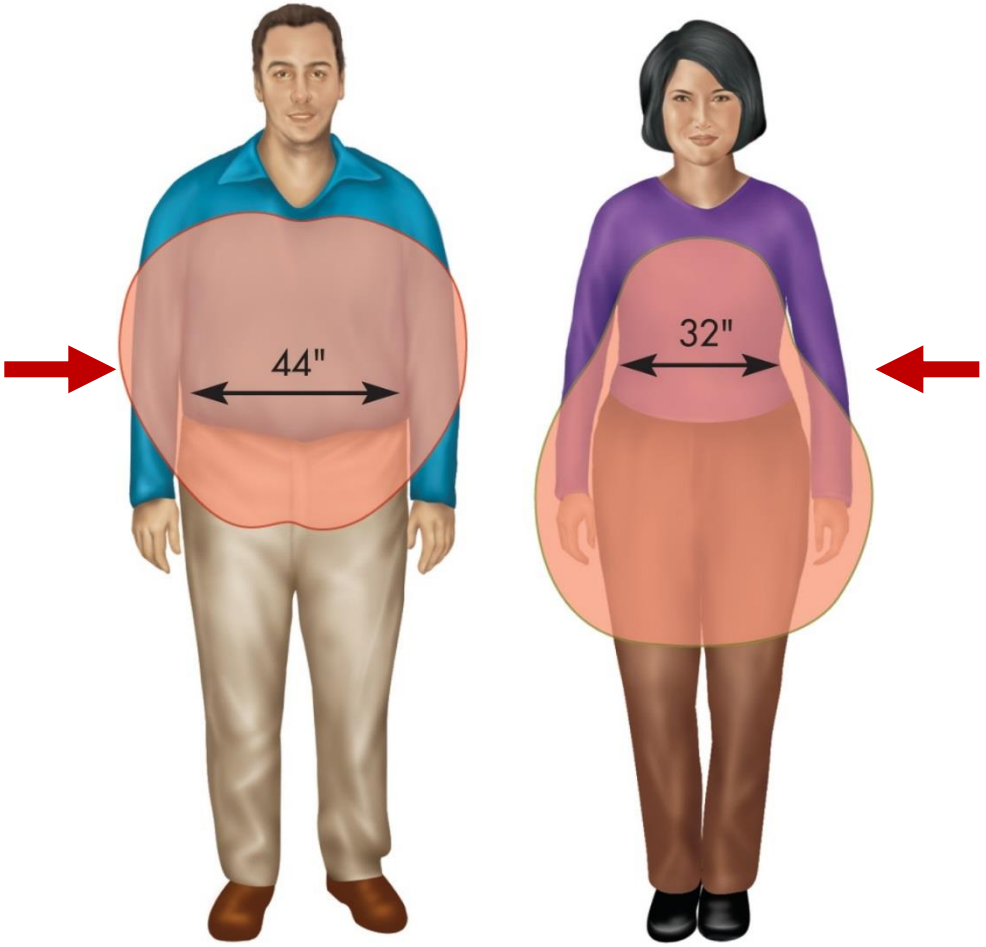
Body Fat Content

Desirable amounts of body fat:

- Men: 8% to 24%; over 24% considered obese
- Women: 21% to 35%; over 35% considered obese
  - Need more body fat because of reproductive functions

Using Body Fat Distribution to Further Evaluate Obesity

- Insulin resistance, fatty liver
- Cardiovascular disease, hypertension, type 2 diabetes
- Testosterone and excessive alcohol
- Abdominal fat is released into the liver and promotes inflammation in the body



- Post menopause
- Estrogen falls
- Raises risk of chronic disease

Estimation of Body Fat

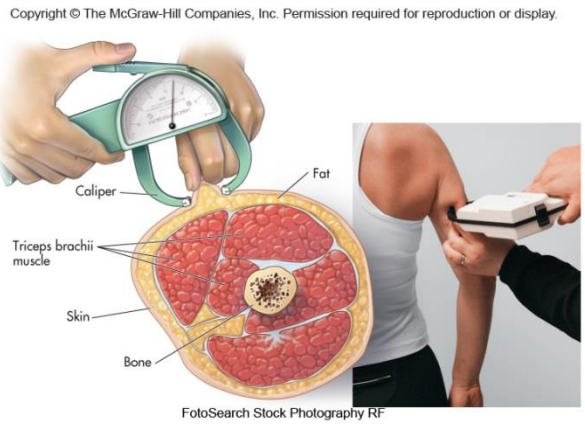
- Underwater weighing
  - Very accurate
  - Fat is less dense than lean tissue
  - Fat floats
- Air displacement
  - Determines the body volume and air displaced in a sealed chamber
  - Body density = Body wt/body volume
- DEXA (dual x-ray photon absorptiometry)
  - X-ray body scan that allows for the determination of body fat
  - Most accurate but expensive

©Paul Efland University of Georgia

BOD POD® Body Composition Tracking System photo provided courtesy of COSMED USA, Inc.

Estimation of Body Fat

- Bioelectrical impedance
  - Low-energy current that measures the resistance of electrical flow
  - Fat is resistant to electrical flow; the more the resistance, the more body fat
- Skinfold Measurements



Nature vs Nurture

What is more important in development of obesity nurture or nature?

How Does Nature Contribute to Obesity?

- Identical twins
  - When raised apart still have similar weights
- Genes
  - Affect metabolic rate, fuel use, brain chemistry, body shape
- Thrifty metabolism gene
  - More fat storage to protect against famine

Does Nurture Have a Role?

- Environmental factors influence weight
- Learned eating habits
- Activity factor (or lack of)
- Poverty and obesity

- Female obesity is rooted in childhood obesity
- Male obesity appears after age 30

Successful weight losers and maintainers from the National Weight Control Registry:

- Eat a low-fat, high-carbohydrate diet (on average 25% of calorie intake as fat).
- Eat breakfast almost every day.
- Self-monitor by regularly weighing oneself and keeping a food journal.
- Exercise for about 1 hour per day.
- Eat at restaurants only once or twice per week.

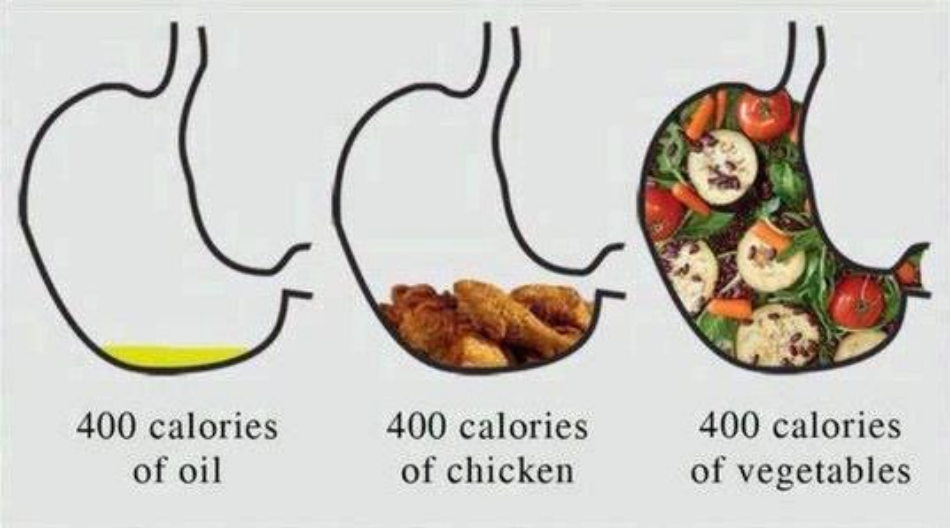
Other recent studies support this approach, especially the last four characteristics.

Weight-Loss Triad

- Obesity is a chronic disease
  - Treatment requires long-term lifestyle changes
  - Realistic expectation of 1 to 2 pounds per week for long-term

Control of Calorie Intake

- Low-fat, high-fiber approaches
  - Most successful in long-term studies
- High satiety foods: volume, protein, fiber, fat
- Keep a food log (portion size awareness)



Other Behavior Modification Strategies

- **Chain-breaking:** Breaking the link between two behaviors ex. snacking while watching television
- **Stimulus control:** Altering the environment to minimize the stimuli for eating, ex. remove foods from sight
- **Cognitive restructuring:** Changing your frame of mind regarding eating ex. replacing stress eating with going for a walk with a friend
- **Contingency management:** Back up plan – don't be a prisoner of circumstance
- **Self-monitoring:** Tracking for accountability

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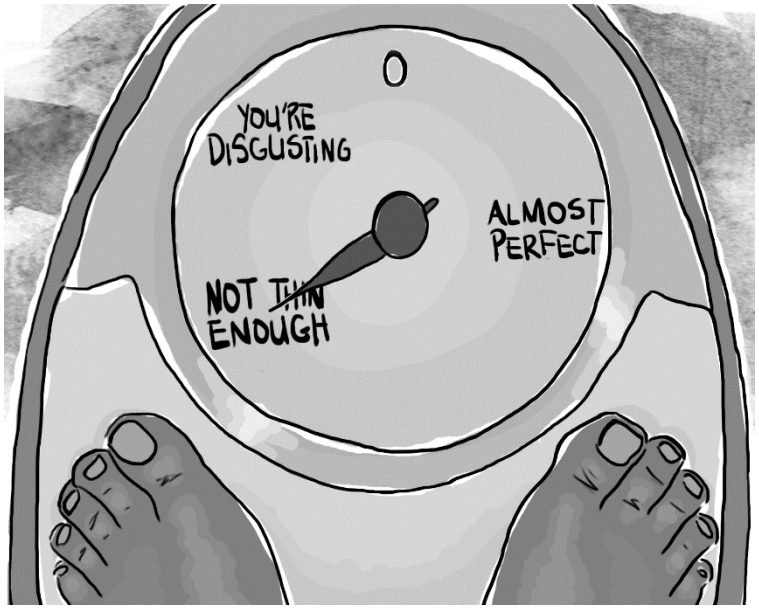
Signs of bad weight loss program???

From Ordered to Disordered Eating Habits

- Media promotion
- Need for social acceptance
- Influence and stress on young individuals
- Eating is a necessity
- Dieting may lead to a disorder




hair looks limp and messy! Fill in.
Create highlights in her skin
Slim jawline
lower top Create more cleavage
Slenderize arm
give breast more lift.
Slim hips please
darken shadows on shirt to make stomach flatter
thinner legs! trim outside & inside and lengthen

Changing Face of Eating Disorders

- Typically develops during adolescence or young adulthood
- Co-occurs with other psychological disorders
- More and more crossing ethnic and cultural groups
- Recognition of disorder is critical to treatment
- *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*

Anorexia Nervosa

- Hair loss
- Fainting/fatigue
- Loss of heart tissue
- Lanugo
- Little subcutaneous fat
- Loss of menstrual periods
- Low bone mass
- Muscle tears/stress fractures
- Low body temperature
- Bruising
- Low metabolic rate/ cold intolerance

Bulimia Nervosa

- Swollen salivary glands
- Irritation of the esophagus
- Stomach ulcers

Binge-Eating Disorder

- Hypertension
- High cholesterol
- Osteoarthritis
- Fatty liver disease
- Atherosclerosis
- Type 2 diabetes
- Some types of cancer
- Sleep apnea

Shared

- Iron-deficiency anemia
- Blood potassium imbalance
- Irregular heart rate
- Dental decay
- Constipation
- Sleep disturbances
- Immune dysfunction
- Infertility

Anorexic Nervosa

Three Criteria:

1. Severely restrict energy intake relative to requirements

2. Intense fear of gaining weight or becoming obese

3. Very distorted body image

Common Behaviors of Anorexia

- Competitive and often obsessive
- Abusive experiences, break up, stress at home
- Abnormal, rigid eating habits
- Eating very little food (300-600 kcal/day)
- Hiding and storing food
- Exercising compulsively, compensatory behavior
- Preparing meals for others, but not eating
- Withdrawing from friends and family
- Critical of self and others
- Sleep disturbances and depression
- Amenorrhea

Physical Effects of Anorexia

Visible

- "Skin-and-bone" appearance
- Rough, dry, scaly, cold skin
- Lanugo and loss of hair
- Loss of teeth

3% will eventually die from disease, suicide, heart ailments, infection

Non-visible

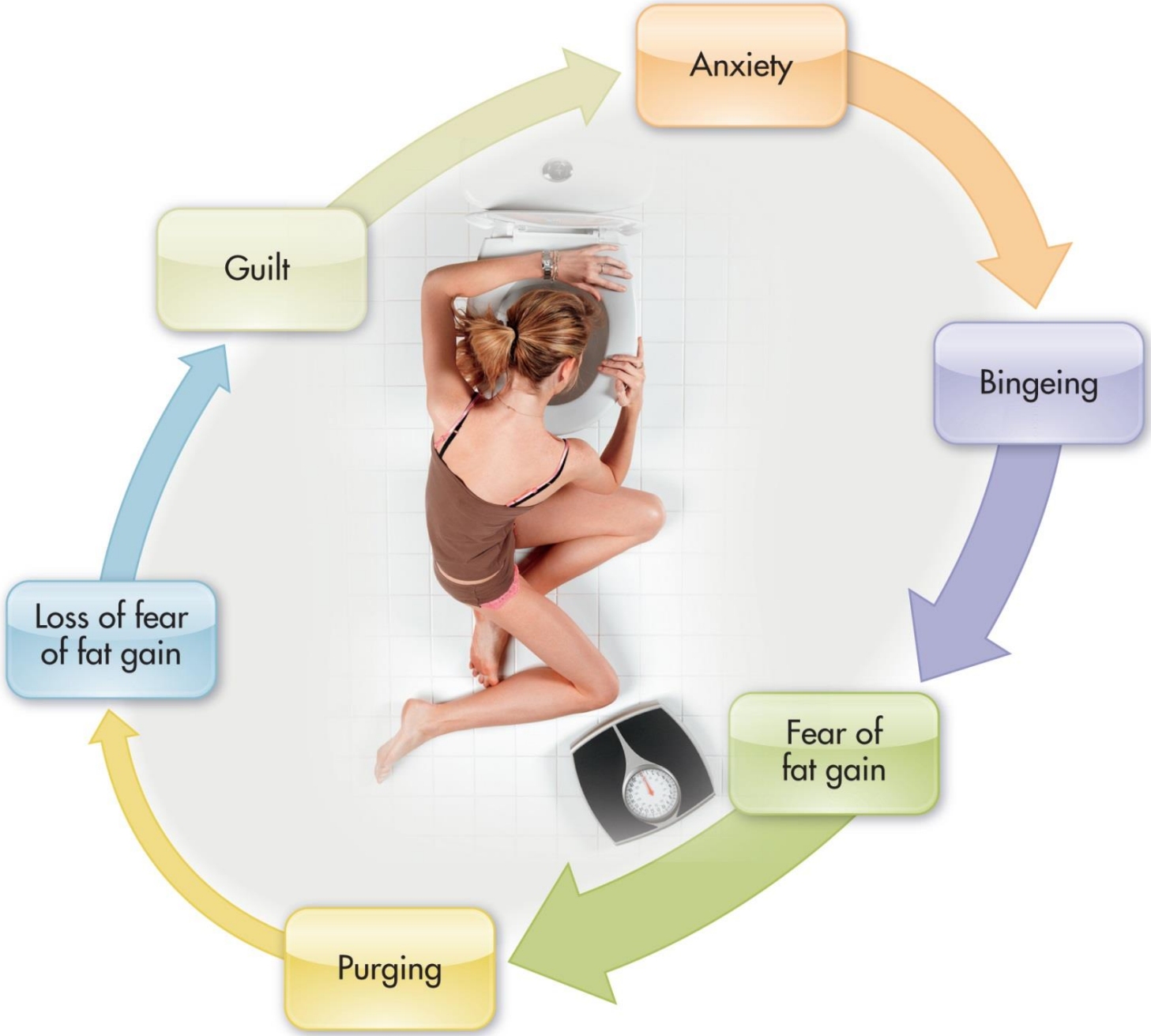
- Slowed basal metabolism & HR
  Lowered body temperature
- Nutrient deficiencies
- Low white blood cell count
- Constipation, amenorrhea
- Osteopenia and osteoporosis
- Depression, sleep disturbances
- Changes in brain size, blood flow to brain & neurotransmitter function
- Muscle tears, stress fractures

Treatment for Anorexia Nervosa

- Nutrition Therapy
  - Ultimately achieve and maintain weight gain
  - Increase food intake to raise basal metabolism
  - Prevent further weight loss
  - Gain 2-3 pounds per week – BMI goal of 20+
  - Restore appropriate food habits
  - Restrict excessive activity
- Psychological Therapy
- Pharmacological Therapy

Bulimia Nervosa

- Translated, bulimia means ravenous (oxlike) hunger
- Recurrent episodes of binge eating followed by some type of **compensatory behavior** to prevent weight gain
  - **compensatory behaviors:** actions taken to rid body of excess calories and/or alleviate guilt, anxiety associated with a binge; include vomiting, misuse of laxatives, or excessive exercise
- Likely many people with bulimic behavior never diagnosed



Physical Effects of Bulimia

- Vomiting causes most health problems
- Demineralization of teeth
- Drop in blood potassium
- Swelling of salivary glands
- Stomach ulcers and bleeding
- Constipation
- Syrup of ipecac is toxic to heart, liver, kidneys

Courtesy of Carl M. Allen, DDS, MSD

Treatment of Bulimia Nervosa

- Decrease episodes of bingeing and purging
- Psychotherapy to improve self-acceptance
- Change “all-or-none” attitude about food
- Correct misconceptions about food
- Establish good, normal eating habits
- Group therapy, long-term therapy
- Antidepressants
- Mortality rate for patients with bulimia nervosa is estimated around 0.4%
- 50% recover completely

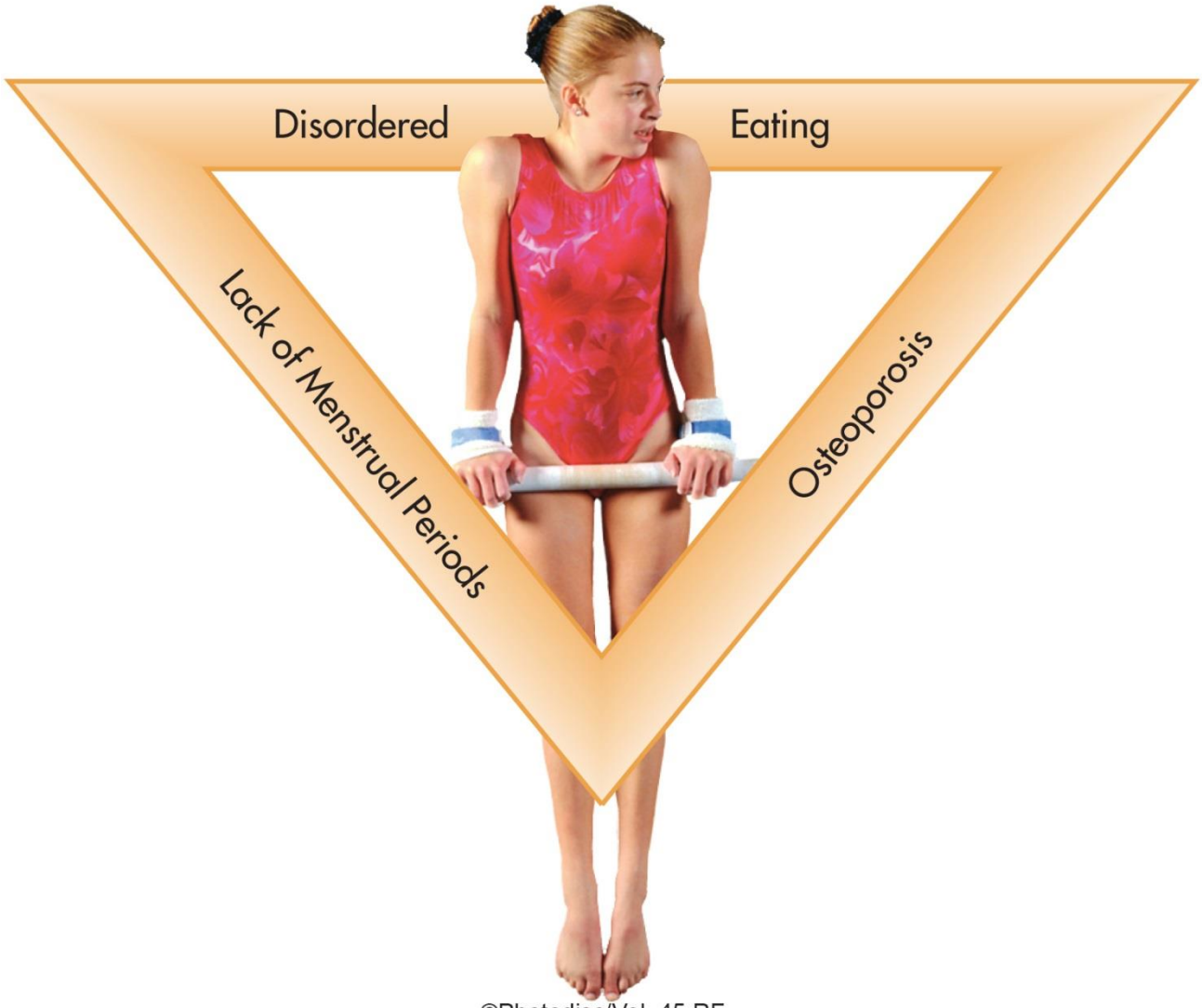
Physical Effects of Binge-Eating

- About 70% are obese, reflect comorbid conditions of obesity
- Hypertension from excess body weight and high sodium intake
- Elevated cholesterol levels
- Cardiovascular disease
- Type 2 diabetes is strongly linked to obesity

Treatment of Binge-Eating Disorder

- Psychological Therapy
  - Cognitive behavioral therapy
- Nutrition Therapy
  - Learn to eat in response to hunger, rather than emotional needs, external factors
  - Avoid diets where deprivation may exist
  - Learn to eat ALL foods in moderation
- Pharmacological Therapy
  - No medications are currently approved by FDA specifically for treatment of binge-eating disorder
  - Antidepressants, antiseizure medications reduce depression and triggers

The Female Athlete Triad



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Profile of Female Athlete Triad

- Female athletes in appearance-based and endurance sports
  - 15% swimmers; 62% gymnasts; 32% other

  1. Disordered eating
  2. Irregular menses or ammenorrhea
  3. Osteoporosis and loss of estrogen
     - Bone density similar to 50-60 year olds
     - Bone loss is largely irreversible

- Plea to teachers, coaches, health professionals to educate about triad

Treatment Suggestions

TREATMENT OF ALL EATING DISORDERS SHOULD BE MULTI DISCIPILNARY :

Nutrition

Pysch

Pharmacy

Prevention of Eating Disorders

- Provide information about changes during puberty
- Carefully phrase weight recommendations
- Don’t overemphasize weight on a scale
- Encourage children to eat only when hungry
- Tolerance for diversity in body weight/shape
- Treat physical, emotional problems early
- Discourage restrictive diets
- Correct misconceptions about foods, diet