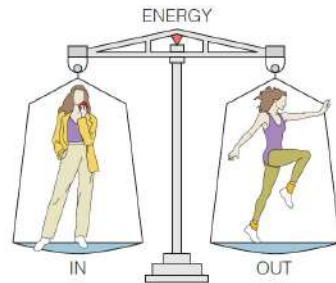
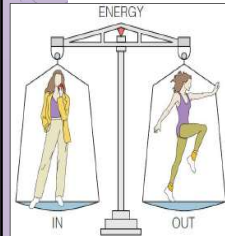


Energy Balance and Body Composition



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Energy Balance



- Body weight is stable when energy consumed is equal to energy expended.
- When energy consumed is greater than expended, weight increases.
- When energy consumed is less than expended, weight decreases.
- One pound of body fat is equal to 3,500 kcalories.

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Energy In: The kCalories Foods Provide

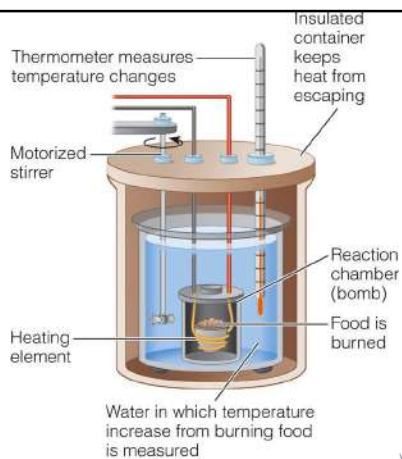
- Eating behaviors respond to different signals.
- Hunger and appetite encourage eating, while satiation and satiety stop eating.
- Messages are sent from the hormonal and nervous system.
- Other aspects of human behavior affect eating habits.

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Energy In: The kCalories Foods Provide

- Food Composition
 - A bomb calorimeter is an instrument that measures the heat energy released when foods are burned.
 - Direct calorimetry measures the heat energy released.
 - Indirect calorimetry measures the amount of oxygen consumed and carbon dioxide expelled.
 - Physiological fuel value is the difference between the number of kcalories measured with calorimetry and the number of kcalories that the human body derives from a food.

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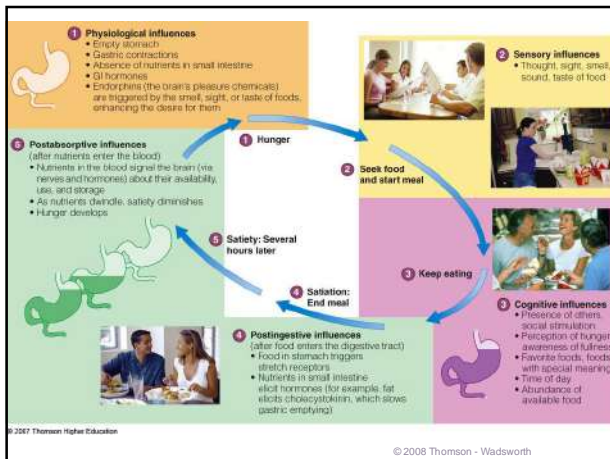
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Energy In: The kCalories Foods Provide

- Food Intake
 - Appetite initiates eating through the sight, smell, thought or taste of food. Hunger is the feeling that motivates us to eat and is controlled by the hypothalamus.
 - Satiation is the feeling of satisfaction and fullness that causes us to stop eating.
 - Satiety reminds us not to eat again until the body needs food.

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Energy In: The kCalories Foods Provide

- Food Intake
 - Overriding Hunger and Satiety
 - Stress eating is eating in response to arousal.
 - Cognitive influences such as perceptions, memories, intellect, and social interactions
 - Sustaining Hunger and Satiety
 - Protein is the most satiating.
 - Complex carbohydrates are satiating.
 - High-fat foods stimulate and entice people to eat more.

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For the same size portion, peanuts deliver more than 15 times the calories and 20 times the fat of popcorn.

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For the same number of calories, a person can have a few high-fat peanuts or almost 2 cups of high-fiber popcorn. (This comparison used oil-based popcorn; using air-popped popcorn would double the amount of popcorn in this example.)

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Energy In: The kCalories Foods Provide

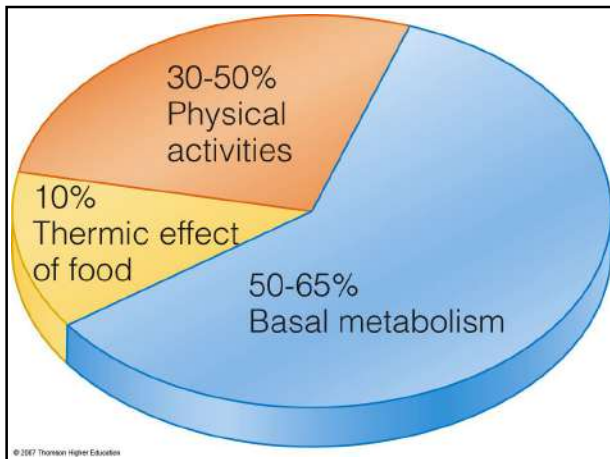
- Food Intake
 - Message Central—The Hypothalamus
 - Integrates messages about energy intake, expenditure, and storage
 - Neuropeptide Y initiates eating, decreases energy expenditure, increases fat storage and causes carbohydrate cravings.

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Energy Out: The kCalories the Body Expend

- Energy expenditure includes basal metabolic activities, physical activity, thermic effect of food and adaptive thermogenesis.
- These energy requirements differ from person to person and are affected by age, gender, weight, and height.
- The intensity and duration of physical activity also make a difference.

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Energy Out: The kCalories the Body Expend

- Components of Energy Expenditure
 - [1] Basal Metabolism (basal metabolic rate, BMR)
 - 2/3 of energy expenditure
 - Supports the basic processes of life
 - Resting metabolic rate (RMR) is a measure of energy slightly higher than BMR.

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Energy Out: The kCalories the Body Expend

- Components of Energy Expenditure
 - [1] Basal Metabolism - Factors affecting BMR
 - Aging slows BMR
 - Height – the taller, the higher the BMR
 - Growth increases BMR
 - Body composition (lean body mass increases BMR)
 - Fever increases BMR.
 - Stress increases BMR.
 - Environmental temperature - both heat and cold raise BMR

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Energy Out: The kCalories the Body Expend

- Components of Energy Expenditure
 - [1] Basal Metabolism - Factors affecting BMR
 - Fasting/starvation slows BMR.
 - Malnutrition slows BMR.
 - Hormones
 - Thyroid hormones can increase or decrease BMR.
 - Premenstrual hormones can increase BMR.
 - Smoking increases BMR.
 - Caffeine increases BMR.
 - Sleep slows BMR.

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Factor	Effect on BMR
Age	Lean body mass diminishes with age, slowing the BMR. ^a
Height	In tall, thin people, the BMR is higher. ^b
Growth	In children, adolescents, and pregnant women, the BMR is higher.
Body composition (gender)	The more lean tissue, the higher the BMR (which is why males usually have a higher BMR than females). The more fat tissue, the lower the BMR.
Fever	Fever raises the BMR. ^c
Stresses	Stresses (including many diseases and certain drugs) raise the BMR.
Environmental temperature	Both heat and cold raise the BMR.
Fasting/starvation	Fasting/starvation lowers the BMR. ^d
Malnutrition	Malnutrition lowers the BMR.
Hormones (gender)	The thyroid hormone thyroxine, for example, can speed up or slow down the BMR. ^e Premenstrual hormones slightly raise the BMR.
Smoking	Nicotine increases energy expenditure.
Caffeine	Caffeine increases energy expenditure.
Sleep	BMR is lowest when sleeping.

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Energy Out: The kCalories the Body Expend

- Components of Energy Expenditure
 - [2] Physical activity
 - Most variable and changeable
 - Voluntary
 - It can be significant in weight loss and weight gain.
 - Duration, frequency and intensity influence energy expenditure.

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Energy Out: The kCalories the Body Expend

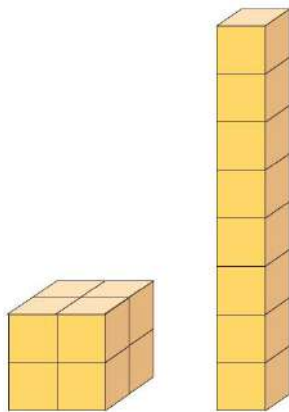
- Components of Energy Expenditure
 - [3] Thermic effect of food (TEF) is estimated at 10% of total energy intake and involves digestion and absorption.
 - Carbohydrate 5-10%
 - Fat 0-5%
 - Protein 20-30%
 - Alcohol 15-20%
 - Adaptive thermogenesis is the adjustment in energy expenditure related to environmental changes.

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Energy Out: The kCalories the Body Expend

- Estimating energy requirements is affected by many factors.
 - Gender – men generally have a higher BMR
 - Growth – BMR is high in people who are growing
 - Age – BMR declines as lean body mass decreases
 - Physical activity – Activities are clustered by intensity and vary considerably
 - Body composition and body size – taller people have more surface area and heavier people have higher BMRs

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Body Weight, Body Composition, and Health

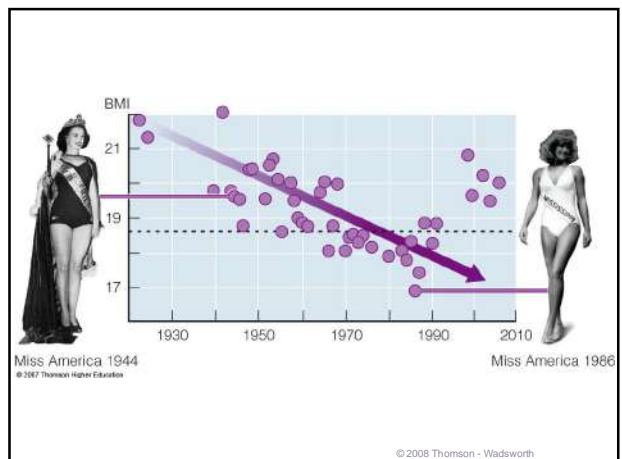
- Current weight standards use height and weight data and do not take body composition into consideration.
- These may be misleading.

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Body Weight, Body Composition, and Health

- Defining Healthy Body Weight
 - The Criterion of Fashion
 - Society values change over time.
 - Perceived body images
 - The Criterion of Health
 - Good health supercedes appearance.
 - Longevity is a criterion.

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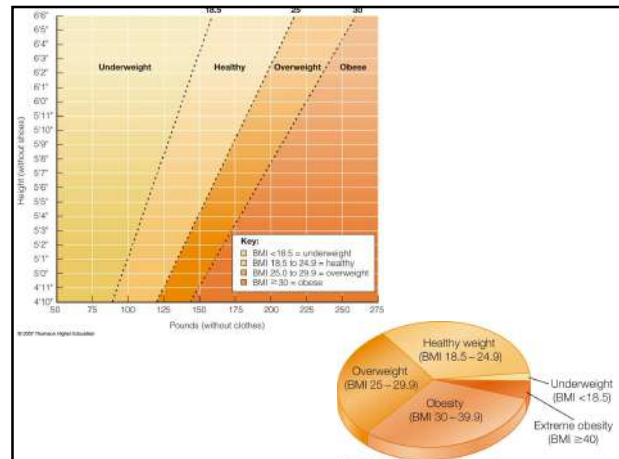


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Body Weight, Body Composition, and Health

- Defining Healthy Body Weight
 - Body mass index (BMI) measures relative weight for height.
 - Underweight is a BMI below 18.5.
 - Overweight is a BMI above 25.
 - Obese is a BMI above 30.

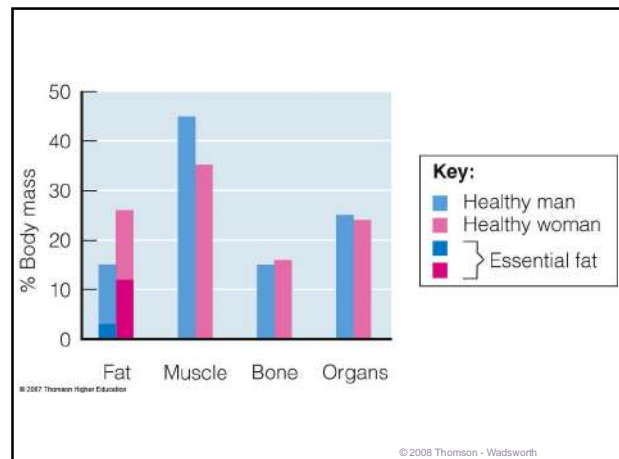
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Body Weight, Body Composition, and Health

- Body Fat and Its Distribution
 - Some People Need Less Body Fat
 - Fat for fuel
 - Fat for insulation and protection
 - Fat to assist in nerve impulse transmissions
 - Fat to support normal hormone activity
 - Some People Need More Body Fat
 - Thresholds differ among individuals
 - Thresholds differ for each function

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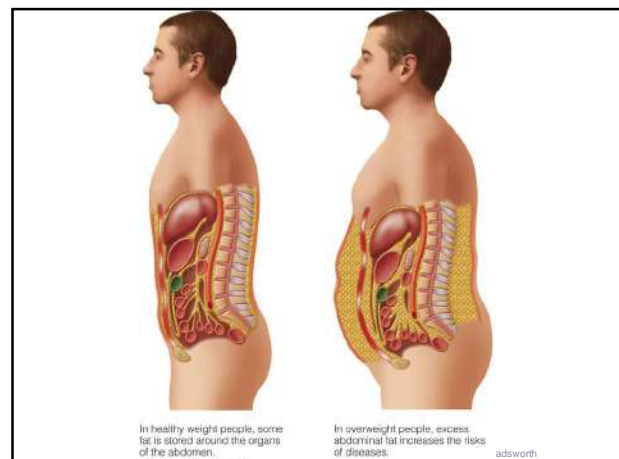


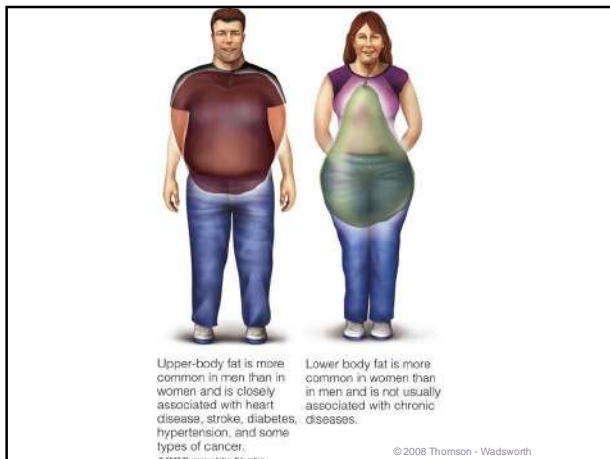
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Body Weight, Body Composition, and Health

- Body Fat and Its Distribution
 - Fat Distribution
 - Intra-abdominal fat around abdominal organs may be critical.
 - Central obesity is excess fat around the trunk of the body. It is also called abdominal fat or upper-body fat.
 - Associated with increased risks

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Body Weight, Body Composition, and Health

- Body Fat and Its Distribution
 - Waist Circumference
 - Practical indicator of fat distribution and abdominal fat
 - $\geq 35'$ is considered high risk for women.
 - $\geq 40'$ is considered high risk for men.

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Body Weight, Body Composition, and Health

- Body Fat and Its Distribution
 - Other Measures of Body Composition
 - Monitoring changes over time is important.
 - Fatfold measures
 - Hydrodensitometry
 - Bioelectrical impedance
 - Air displacement plethysmography
 - Dual energy X-ray absorptiometry (DEXA)

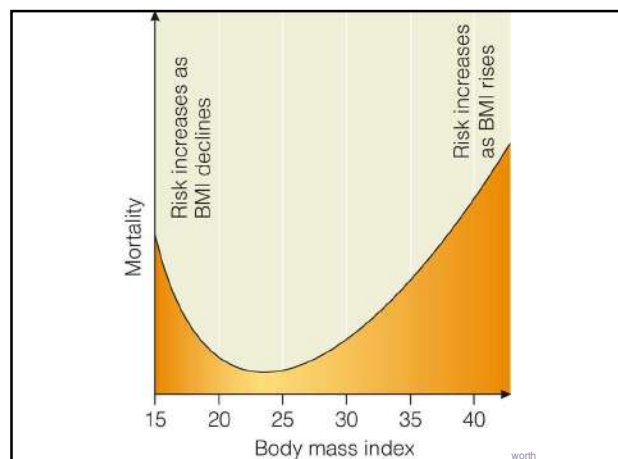
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Body Weight, Body Composition, and Health

- Health Risks Associated with Body Weight and Body Fat
 - An appropriate weight for an individual depends on many factors which include body fat distribution, health history and current state of health.
 - Health Risks of Underweight
 - Cannot handle medical stresses
 - Menstrual irregularities and infertility
 - Pregnancy problems
 - Osteoporosis and bone fractures

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Body Weight, Body Composition, and Health

- Health Risks Associated with Body Weight and Body Fat
 - Health Risks of Overweight
 - Diabetes
 - Hypertension
 - Cardiovascular disease
 - Sleep apnea
 - Osteoarthritis
 - Some cancers
 - Gallbladder disease
 - Kidney disease
 - Respiratory problems
 - Complications in pregnancy and surgery

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Body Weight, Body Composition, and Health

- Health Risks Associated with Body Weight and Body Fat
 - Cardiovascular disease and obesity have a strong relationship.
 - Diabetes and obesity have a strong relationship.
 - Insulin resistance and obesity have a strong relationship.

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Body Weight, Body Composition, and Health

- Health Risks Associated with Body Weight and Body Fat
 - Inflammation and the Metabolic Syndrome
 - High blood pressure
 - High blood glucose
 - High blood triglycerides
 - Low HDL cholesterol
 - High waist circumference

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Body Weight, Body Composition, and Health

- Health Risks Associated with Body Weight and Body Fat
 - Cancer risk increases with weight gain but the relationship is unclear.
 - Fit and Fat versus Sedentary and Slim
 - Healthy weight is important.
 - Cardiorespiratory fitness is important.

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Reference

Whitney E, Rolfes SR. 2011. Energy balance & body composition, in Understanding Nutrition 12th ed. Int'l student ed. Thomson Learning Inc., USA, pp. 240 – 260.

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