Obesity

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Obesity

- A disorder affecting body weight regulatory systems
- Characterized by an accumulation of excess body fat
- Primitive societies vs. developed ones! (availability & activity)
- Prevalence increases with age
- Risk of associated diseases (diabetes, hypertension, cardiovascular disease)
- Childhood obesity: three fold increase in prevalence over the last two decades
- In fact, there are more obese than undernourished individuals worldwide

Assessment of Obesity

BMI Body Comparison ©2005 HowStuffWorks
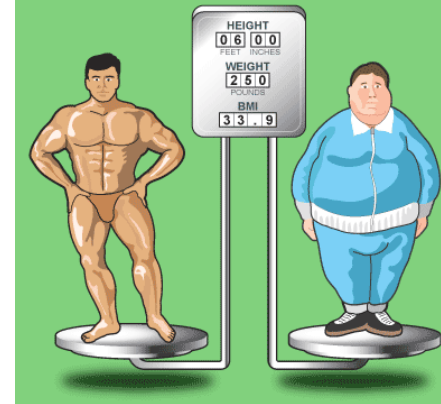
A. Body mass index:

- A measure of relative weight, adjusted for height

- Allows comparisons both within & between populations

- BMI = (weight in kg)/(height in meters)^2

- Healthy = 19.5-25.0

- Overweight = 25-29.9

- Obese = ≥30

- ≈ 2/3 of American adults are overweight & > 36% are obese

WEIGHT FOR HEIGHT CHART FOR MEN AND WOMEN FROM 18 YEARS AND OVER
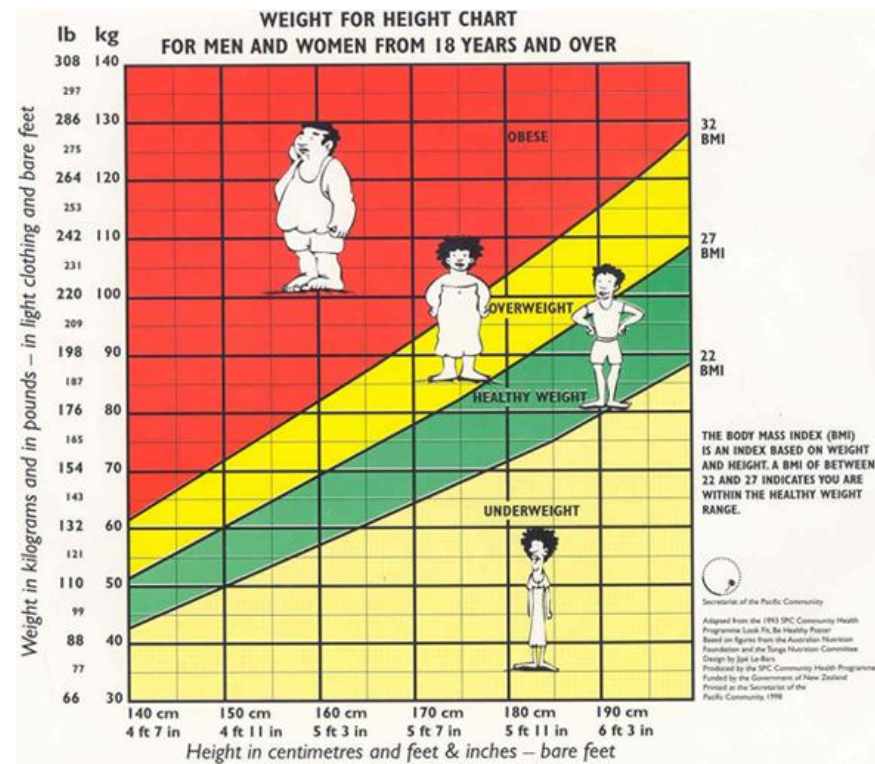
Assessment of Obesity
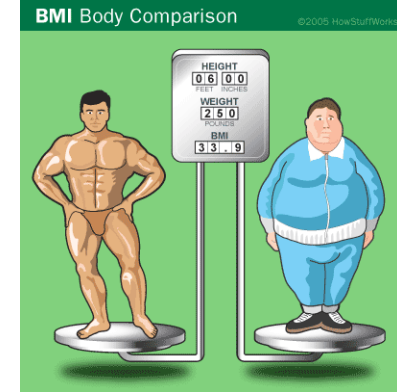
B. Anatomic differences in fat deposition (W/H ratio)

1. Android, "apple-shaped," or upper body obesity: excess fat located in the central abdominal area of the body

   ✓ Associated with a greater risk for hypertension, insulin resistance, diabetes, dyslipidemia, & coronary heart disease

   ✓ Waist to hip ratio: >0.8 for women & > 1.0 for men

2. Gynoid, "pear-shaped," or lower body obesity: fat distributed in the lower extremities around the hips or gluteal region

   ✓ Waist to hip ratio: < 0.8 for women & < 1.0 for men

   ✓ Relatively benign healthwise

   ✓ Commonly found in females
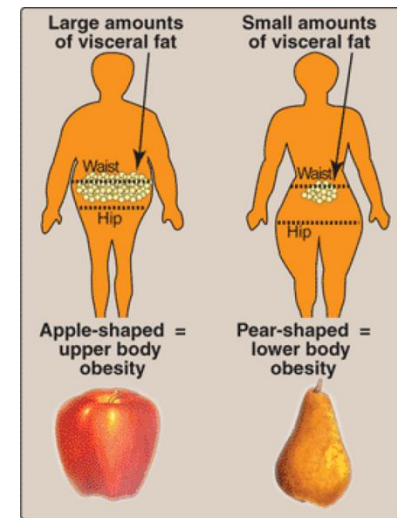
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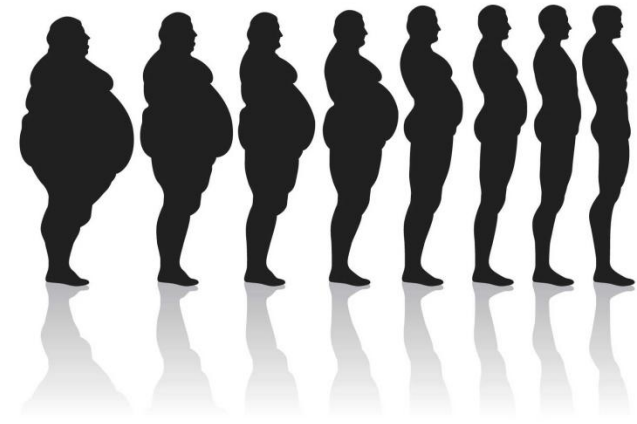
C. Biochemical differences in regional fat depots
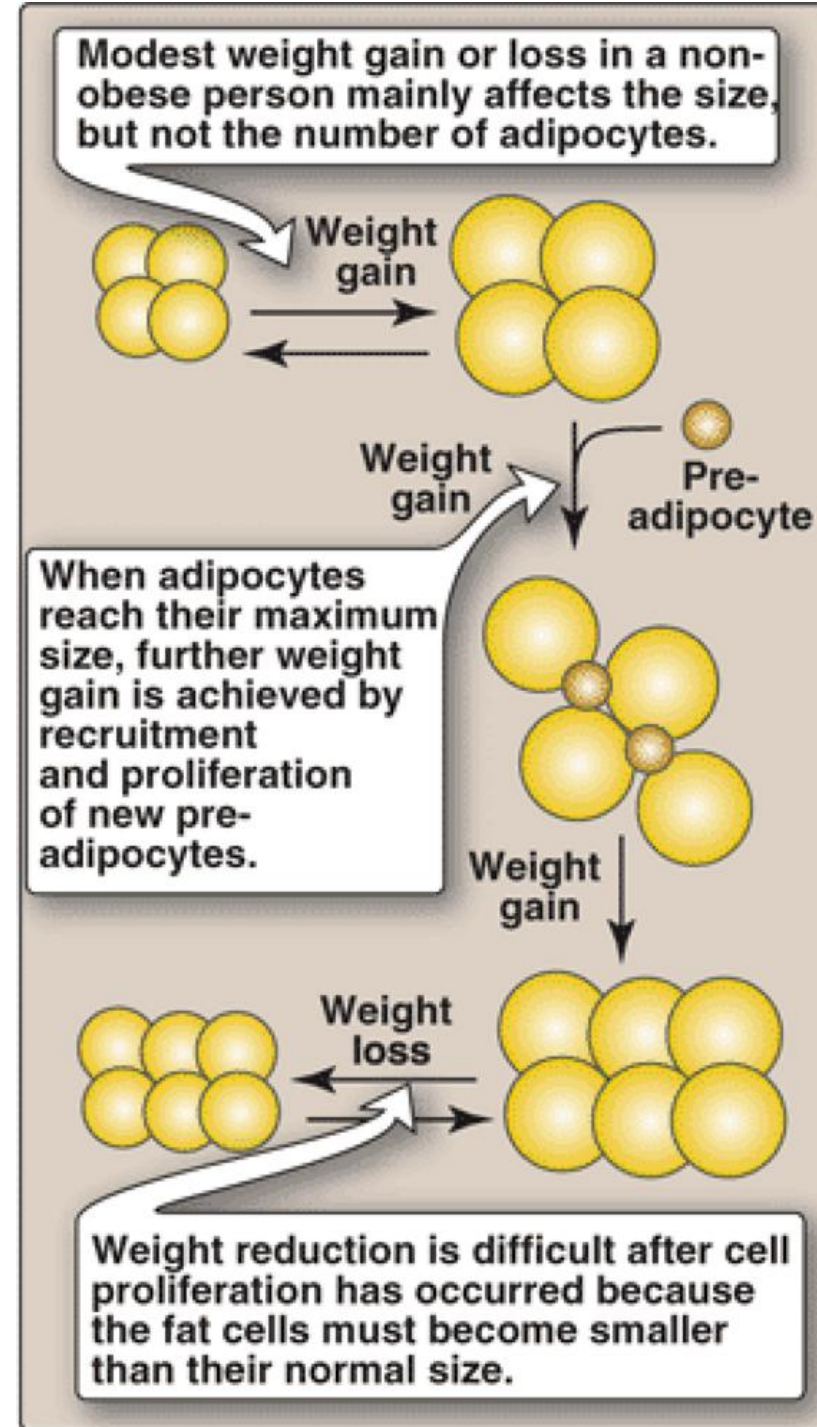
1. Abdominal fat:

- Cells are much larger

- Higher rate of fat turnover

- Hormonally more responsive

- Readily mobilizable: men lose weight more readily than women

- Portal vein: fatty acids may lead to insulin resistance & increased synthesis of triacylglycerols, which are released as very-low-density lipoprotein (VLDL)

2. Gluteal fat: fatty acids from gluteal fat enter the general circulation, & have no preferential action on hepatic metabolism

Assessment of Obesity

D. Number of fat cells

- The ability of a fat cell to expand is limited (division)

- Fat cells, once gained, are never lost!

- Formerly obese patients have a particularly difficult time maintaining their reduced body weight

Modest weight gain or loss in a non-obese person mainly affects the size, but not the number of adipocytes.

Weight gain

Weight gain

Pre-adipocyte

When adipocytes reach their maximum size, further weight gain is achieved by recruitment and proliferation of new pre-adipocytes.

Weight gain

Weight loss

Weight reduction is difficult after cell proliferation has occurred because the fat cells must become smaller than their normal size.

Body Weight Regulation

Body weight is stable as long as the behavioral & environmental factors that influence energy balance are constant

A. Genetic contributions to obesity

- Uncontrolled, gluttonous eating behavior

- Genetic mechanisms play a major role in determining body weight (rather than a lack of willpower)

- Often observed clustered in families

- 80% when parents fat, 9% when parents are lean

- Inheritance is not simple mendelian genetics (a complex polygenic disease)

- Adopted children usually correlates with biologic parents

- Identical twins have very similar BMI

B. Environmental & behavioral contributions

- The epidemic of obesity occurring over the last decade! genetic factors are stable on this short time scale

- Environmental & behavioral:
  - ✓ Ready available food
  - ✓ Energy-dense food
  - ✓ Sedentary lifestyles: TV watching, automobiles, computer usage, & energy-sparing devices
  - ✓ Eating behaviors: snacking, portion size, number of people

- Men in Japan (aged 46–49 years) are lean (BMI = 20), in California (BMI = 24)
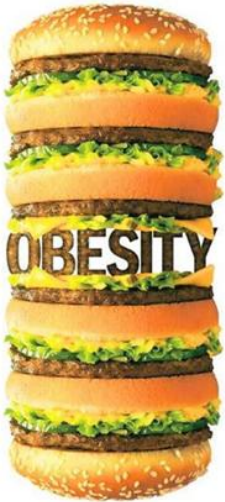
Molecules that Influence Obesity

Obesity results when energy intake exceeds energy expenditure

Hormones of adipose tissue

- Leptin:

  - ✓ The product of the ob gene

  - ✓ Produced proportionally to the adipose mass

  - ✓ Informs the brain of the fat store level

  - ✓ Regulate body fat through the control of appetite & energy expenditure

  - ✓ Suppressed by depletion of fat stores (starvation) & enhanced by expansion of fat stores (well-fed state)

  - ✓ Daily injection of leptin in mice

  - ✓ Plasma leptin in obese humans is usually normal for their fat mass (resistance to leptin rather than deficiency)
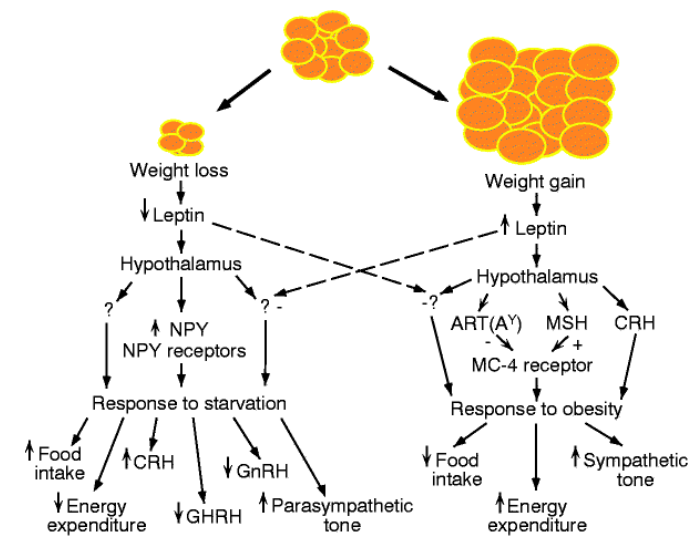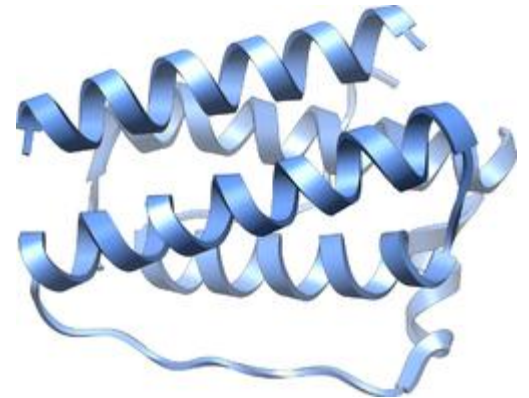
Metabolic Changes Observed in Obesity

Metabolic syndrome
(Syndrome X)
- Central obesity
- High blood pressure
- High triglycerides
- Low HDL-cholesterol
- Insulin resistance

A. Metabolic syndrome (insulin resistance syndrome, syndrome X)

  ✓ Glucose intolerance, Insulin resistance, Hyperinsulinemia

  ✓ Dyslipidemia (low HDL & high VLDL)

  ✓ Hypertension

- Increased risk for diabetes mellitus & cardiovascular disorders (men: 4 times higher mortality of cardiovascular disease)
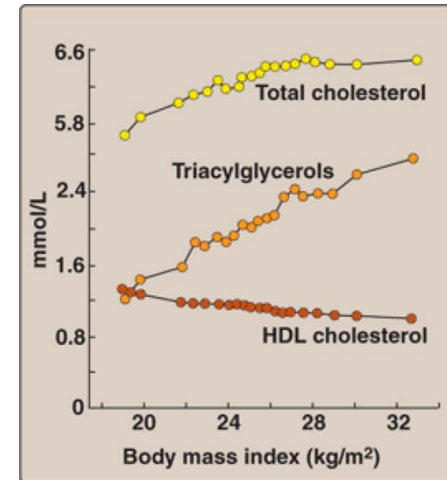

B. Dyslipidemia

- Insulin resistance causes increased activity of hormone-sensitive lipase, resulting in increased levels of circulating fatty acids

- In liver converted to triacylglycerol & cholesterol

- Released as VLDL, resulting in elevated serum triacylglycerols. Concomitantly, HDL levels are decreased

Obesity and Health

- Correlated with increased risk of death

- Risk factor for:
  - ✓ Adult onset diabetes
  - ✓ Hypercholesterolemia
  - ✓ High plasma triacylglycerols
  - ✓ Hypertension
  - ✓ Heart disease
  - ✓ Some cancers
  - ✓ Gallstones
  - ✓ Arthritis
  - ✓ Gout

- The relationship is stronger for <55 years

- After age 74, there is no association between increased BMI & mortality
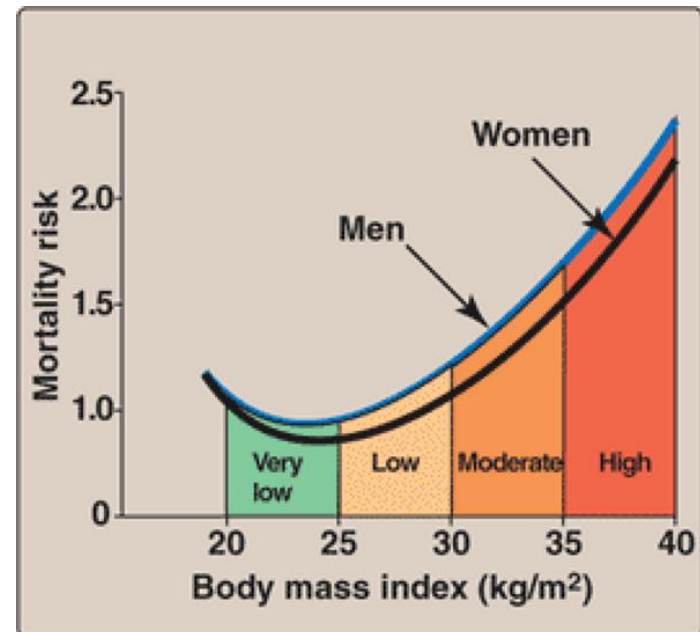
Weight Reduction

A. Physical activity

o Create an energy deficit

o Increases cardiorespiratory fitness

o Combine caloric restriction & exercise with behavioral treatment may lose about 5–10% of body weight over a period of 4–6 months

B. Caloric restriction

o The most common approach

o 1 pound of adipose tissue corresponds to approximately 3,500 kcal

o Ineffective over the long term for many individuals

MANSAF
LAMB, RICE
FERMENTED YOGURT
+ ROASTED ALMONDS
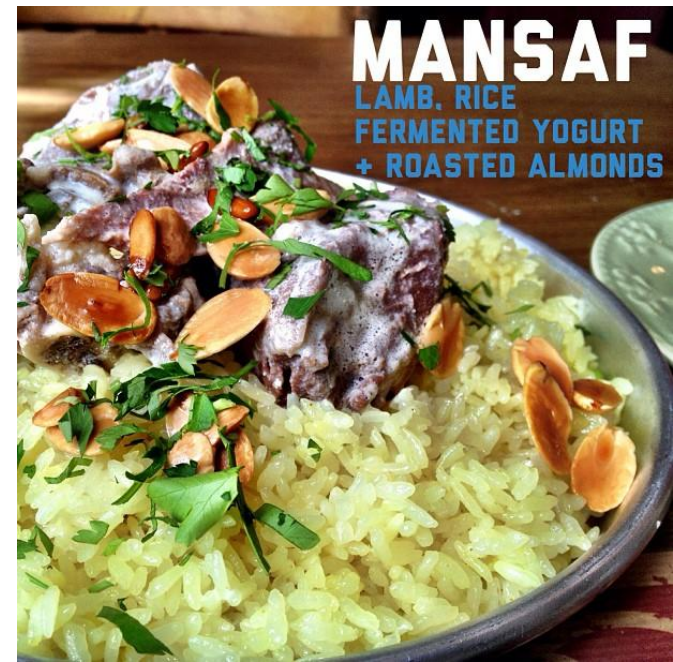
Weight Reduction

- C. Pharmacologic & surgical treatment

- Two medications (BMI ≥ 30):
  - ✓ Sibutramine: appetite suppressant that inhibits the reuptake of both serotonin & norepinephrine
  - ✓ Orlistat: lipase inhibitor that inhibits gastric and pancreatic lipases

- Surgical procedures are an option for the severely obese patients

- Surgery produces greater & more sustained weight loss than dietary or pharmacologic therapy, but has substantial risks for complications