Carbohydrates
Carbohydrate Lecture Topics

- Review of carbohydrates
- Diabetes
- Sugar
  - Sugar sweetened beverages
Carbohydrates Review

Types of carbohydrates

- **Monosaccharides** - One sugar
  - Glucose, Fructose and Galactose

- **Disaccharides** - Two monosaccharides bonded together
  - Sucrose, Maltose and Lactose

- **Polysaccharides** - Many monosaccharides bonded together
  - Starch, Dietary Fiber, Glycogen
Carbohydrate Review

- **Glycogen**
  - Storage form of glucose
  - Stored in liver and muscle
  - Limited storage capacity - about a day's worth stored away
  - Broken down when blood glucose level are low
Carbohydrate Review

Function of Carbohydrates
- Glucose major energy source for the body
- Brain requires a constant supply of glucose
- Provides 4 kcals/g
Carbohydrate Review

Control of blood glucose levels

- Insulin
  - Produced when glucose levels rise (after meal)
  - Assist cells in drawing glucose out of blood
  - Lowers blood glucose levels

- Glucagon
  - Produced when glucose levels are low (fasting)
  - Stimulates liver to release glucose from glycogen
  - Increases blood glucose levels
Carbohydrate Review
Carbohydrate Review

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Fiber and Health

- **Dietary Fiber**
  - Nondigestible parts of plants that form the support structures of leaves, stems and seeds

- **Functional Fiber**
  - Nondigestible forms of carbohydrates that are extracted from plants or manufactured in a laboratory. Added to foods or used in fiber supplements.
  - Examples: cellulose, guar gum, pectin and psyllium.
Fiber and Health

Benefits

- May reduce risk of colon cancer
  - Binds cancer causing substances and speeds elimination
- Promotes bowel health
  - Prevents hemorrhoids, constipation
- Reduces risk of diverticulosis
  - Easy elimination
- Reduces risk of heart disease
  - Binds and excretes bile, use cholesterol to make new bile
- Enhance weight loss
  - Fiber absorbs water, promotes fullness
- Low risk of type 2 diabetes
  - Slows release of glucose into bloodstream
Fiber and Health

**Recommendations**

- 14 g of fiber for every 1,000 kcals consumed
- Adequate intake:
  - Women = 25 g per day
  - Men = 38 g per day
- Most eat 12-18 grams per day
Fiber and Health

- Navy beans, cooked – ½ cup
- Lentils, cooked – ½ cup
- Black beans, cooked – ½ cup
- Kidney beans, cooked – ½ cup
- Blackberries – 1 cup
- Pear – 1 medium with skin
- Banana – 1 medium
- Strawberries, fresh – 1 cup
- Broccoli, cooked – 1 cup
- Corn, canned – 1 cup
- Asparagus, cooked – 6 spears
- Lettuce iceberg – 1 cup
- Oatmeal, instant – 1 packet
- Pumpemkkel bread – 1 slice
- Whole-wheat bread – 1 slice
- White bread – 1 slice

Fiber content (grams)
Fiber and Health

Tips

- Select breads made with whole grains
  - Wheat, oats, barley or rye
- Eat legumes (1/2 cup = 8 grams of fiber)
  - Add to soup or salad
- Choose fresh fruits and vegetables as snacks
- Switch to a high fiber cereal
  - >4g fiber per serving
Diabetes

Definition
- A chronic disease in which the body can no longer regulate glucose levels
- Typically untreated diabetes results in hyperglycemia
- Normal blood glucose level = 80-100 mg/dl

Statistics
- 8.3% of US population has diabetes
- Estimated that 7 million have diabetes and do not know it
Diabetes

Diagnosis

- **A1C test**
  - A measure of average blood glucose for the past few months.
  - Diabetes diagnosis A1C > 6.5

- **Fasting plasma glucose**
  - Diabetes diagnosis blood glucose > 126 mg/dl

- **Oral glucose tolerance test**
  - Checks blood glucose before and 2 hours after a sweet drink
  - Diabetes diagnosis > 200 mg/dl
Oral glucose tolerance test

![Graph showing plasma glucose levels over time after oral glucose administration for normal and diabetic conditions.](image-url)
Diabetes

Symptoms
- Frequent urination
- Increased thirst
- Hunger
- Weight loss
- Fatigue
- Blurry vision
- Cuts that are slow to heal
- Tingling or numbness in hands/feet
Diabetes

Complications

- Diabetic Ketoacidosis
  - Impaired carbohydrate metabolism
    - Lack of insulin, glucose trapped in blood
    - Body still needs glucose and energy
  - Break down of fat, producing ketones (alternate fuel)
  - Ketones can suppress appetite, cause dehydration and acetone breath
  - Ketones are acids and can make the blood very acidic
  - Can result in coma and death
Diabetes

Complications - Long term

- CVD
  - Leading cause of death in people with diabetes
- Eye disease
  - High blood glucose level can cause small blood vessels to swell and leak fluid into the retina (blurring of vision), can lead to blindness
Diabetes

Complications

- Kidney disease
  - Blood vessels become damaged from hyperglycemia and affect kidneys ability to filter waste.

- Nerve Damage
  - High blood glucose can damage the vessels that bring oxygen to some nerves

- Amputation
  - Nerve damage, circulation problems and infections can lead to amputation
Type 1 Diabetes

- 5% of diabetes cases
- Most cases diagnosed in adolescents
- Autoimmune disease
  - Body’s immune system attacks the beta cells of the pancreas
- Blood glucose levels rise
- Kidneys try to excrete excess glucose
- Body uses fat rapidly - causing ketoacidosis
Type 1 Diabetes

- Treatment
  - Insulin
    - Insulin shots
    - Insulin pump
  - Monitor blood glucose levels
  - Diet
  - Exercise
Type 1 Diabetes

Insulin

- Different types depending on how quickly they work, when they peak and how long they last
- All insulin available in the US is manufactured in a laboratory
- How much insulin is needed depends on carbohydrate intake and blood glucose level
Type 2 Diabetes

- 95% of diabetes cases - increasing in young population
- Develops progressively over time
- Body cells become resistant to insulin
- Obesity is common
  - 80-90% of type 2 diabetics overweight or obese
  - Accumulation of lipids in liver, muscle and beta cells of pancreas reduces cells ability to respond to insulin
- Results in high blood glucose levels
- Pancreas at first may produce lots of insulin, can eventually stop producing insulin
Type 2 Diabetes

Risk Factors for Type 2 Diabetes

- > 45 years of age
- Overweight
- Parent or sibling with diabetes
- Family background is African-American, Hispanic/Latino, American-Indian or Pacific Islander
- Physically active < 3 times per week
Type 2 Diabetes

Treatment

1. *Meal planning, weight loss and exercise*

2. Medications
   - Some stimulate beta cells to release more insulin
   - Some limit production of glucose by liver
   - Some block the breakdown of starches in intestine

3. Insulin
Type 2 Diabetes

**Dietary Management**
- Eat same amount and types of food at each meal
- Avoid skipping meals
- Increase high fiber foods
- Portion Control
- Consistent Carbohydrates
- Can have sugar at times - limited amounts and good blood glucose control
Type 2 Diabetes

► Prevention
  ► If overweight
    ► Losing 7% of body weight (20lbs if individual weighs 300lbs)
  ► Exercising moderately
    ► 30 minutes a day/ 5 times a week
Gestational Diabetes

- Diabetes during pregnancy
- Occurs more frequently in obese mother, over > 35 years of age
- Usually disappears after birth
- Increased risk of developing Type II Diabetes
- Treatment consists of exercise, medication and diet. Weight loss never recommended while pregnant.
Sugar

- Naturally occurring sugar - found in dairy (lactose) and fruit (fructose)
  - Found in foods rich in other nutrients (fiber, calcium, vitamin D, Vitamin C)
- Added sugar
  - Look for ingredients like:
    - Brown sugar
    - Corn sweetener
    - Corn syrup
    - High fructose corn syrup
    - Sucrose
    - Fruit juice concentrate
    - Molasses
- On food labels sugars listed on the nutrition facts panel include both naturally occurring sugar and added sugar (this may change)
Sugar

Ingredients: Granola (whole grain rolled oats, sugar, rice flour, whole grain rolled wheat, partially hydrogenated soybean oil, whole wheat flour, molasses, sodium bicarbonate, soy lecithin, caramel color, barley malt, salt), corn syrup, crisp rice (rice, sugar, salt, barley malt), semisweet chocolate chunks (sugar, chocolate liquor, cocoa butter, soy lecithin), sugar, corn syrup, glycerin, high fructose corn syrup, calcium carbonate, fructose, water, salt, natural and artificial flavors.
Sugar

Greatest sources in US diet?

- #1 = Sweetened soft drinks
- Cookies, cakes, pies, fruit drinks, candy

- These foods are generally also low in vitamins, minerals and fiber.
- We tend to consume these in large portions
Source of Sugar Matters!

**Apple**
- 72 calories
- 19 grams carbohydrates
- Fiber
- Magnesium
- Potassium
- Vitamin A
- Folate
- Vitamin C

**12 ounce Coke**
- 136 calories
- 35 grams carbohydrates
- Sodium
Sugar and Health Problems

- **Tooth decay**
  - Bacteria in mouth thrive on sugar and produce acids that eat away the protective tooth enamel

- **Hyperactivity**
  - No strong evidence that sugar causes hyperactivity

- **Blood lipid levels**
  - High sugar intake associated with increased LDL and decreased HDL levels

- **Diabetes**
  - Recent studies suggest strong link between sugar sweetened beverages and diabetes risk
Sugar Sweetened Beverages

- Sugar sweetened beverages
  - Soft drinks, fruit drinks, energy drinks, sport drinks and vitamin waters
- Increased 3 fold since 1970’s in children
- Estimate 10% of some children’s energy intake comes from sugar sweetened beverages
Sugar Sweetened Beverages

- High amounts of added sugar
  - Some don’t compensate by increasing energy expenditure or reducing energy intake from other foods

- High Fructose Corn Syrup (HFCS)
  - Made by converting starch in corn to glucose then to fructose (sweeter)
  - Cheap to make
  - Does not stimulate insulin release
    - Insulin inhibits food intake in people
    - Leads to high calorie intake
  - Is replacing HFCS with other sugars the answer??????
    - Beverages still high in calories, still empty calories
Sugar Sweetened Beverages

Coke

- 12 ounces
- 140 calories
- 39 g sugar
Sugar Sweetened Beverages

**Vitamin Water**

- Consumption of whole bottle (20 ounces)
  - 125 calories
  - 32.5 grams of sugar
Sugar Sweetened Beverages

**Gatorade**

- Consumption of whole bottle (32 ounces)
  - 200 calories
  - 56 grams of sugar
Sugar Sweetened Beverages

Increased consumption due to:

- Advertising
- Increases in serving size
- Unlimited access
- Low cost
Sugar Sweetened Beverages

Sport Drinks
- Developed for endurance athletes the need to replenish carbohydrates, fluid and electrolytes
- Recreationally active athletes
  - Do not need sport drinks
  - Exercise < 1 hours - Water will rehydrate and next meal will replace electrolytes
- Inactive individuals
  - Likely to gain weight
- Kids
  - Increased marketing as replacement for soda
  - Consumption increases risk for weight gain and tooth decay
- Recommendations
  - Sport drinks only used by children engaging in prolonged, vigorous sports activities
  - Children engaged in routine physical activity - plain water is appropriate
How do we decrease consumption of sugar sweetened foods/beverages?

- Taxes?
- Banning from schools?
- Warning label
- Decreasing cost of healthy beverages and foods
- Limiting portion sizes - NYC
Carbohydrate Recommendations

- Empty calorie foods
  - High in calories, low in nutrients
  - Soda, cake, cookies, candy bars, etc
  - These are the carbohydrates we should limit

- Nutrient dense foods
  - Low in calories, high in nutrients
  - Vegetables and fruit, whole grains
  - These are the healthy carbohydrates
Carbohydrate Recommendations

- The Acceptable Macronutrient Distribution Range - 45-65% of total calories from carbohydrates
- RDA for adults 130g Carbohydrates a day
- Dietary Guidelines
  - Consume at least half of all grains as whole grains
  - Increase fruit and vegetable intake
  - Replace refined grains with whole grains
  - Choose foods that provide more dietary fiber. These foods include fruit, whole grain, vegetables and beans.
  - Drink water instead of soda or sweetened beverages