CARBOHYDRATES

fact sheets for health professionals

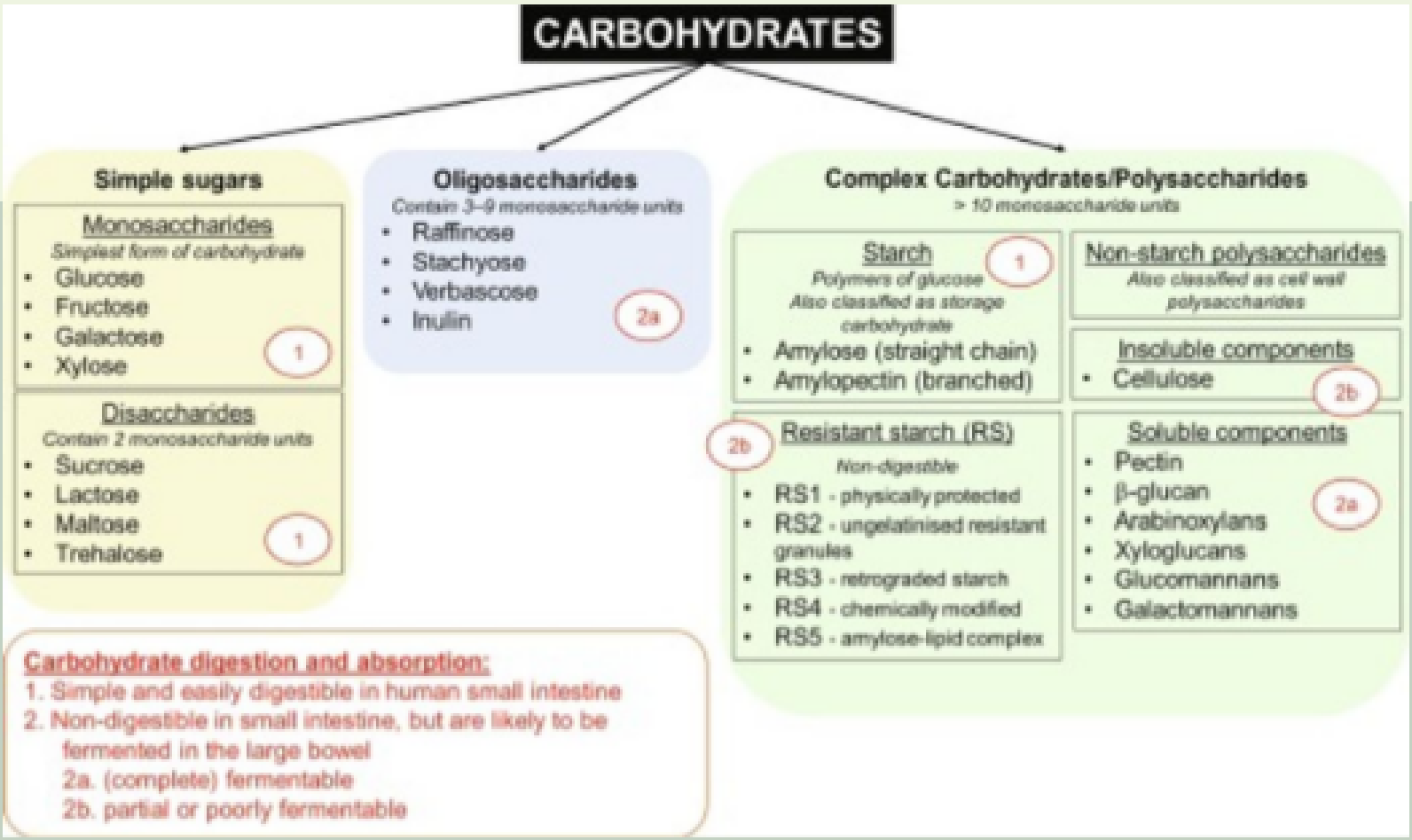
- INTRODUCTION (FUNCTIONS)
- TYPES OF CARBOHYDRTAES
- RECOMMENDATIONS INTAKE (RDA's)
- FIBER TYPES, BENEFITS, CONSUMPTION
- REGULATION OF BLOOD GLUCOSE
- COMPARISON IN GI & GL
- BENEFICIAL INFO FOR CHORNIC DISEASE

Introduction

Carbohydrates & Functions

- **Compositions**: one of the essential macronutrients.They are organic compounds composed of carbon (C), hydrogen (H), and oxygen (O) atoms.
- **Energy Source:** From carbohydrates form to monosaccharide glucose molecules, utilize for immediate use, while not use, it is stored as Glycogen in liver and muscles (for future)
- **Blood sugar regulation**: Low GI (glycemic index) food break down to glucose more slowly and sustained the spike of glucose to vein.
- **Brain and Muscle fuel:** In brain, crabs derive to glucose and sustain in cognitive functions and repairing tissues. In Muscle, Carbs derive to glycogen and store at the muscle for future use.
- **Digestive and Weight management:** Fiber as indigestible food source are high in satiety, aiding in bowel movement, nurturing gut microbiome and prevent constipation which as help in weight management

Types of Carbohydrates



Simple Carbs(Sugars):

(1-2 sugar molecules)
Monosaccharides: Glucose, fructose & galactose.
Disaccharides: combination of 2 monosaccharides:
Sucrose (glucose+fructose)
lactose (glucose + galactose)
Maltose (glucose + glucose)

Oligosaccharides

(3-10 sugar molecules):
Short chains of sugar molecules, found in some legumes and vegetables.

Complex Carbs (Starches)

(>10sugar molecules)
Polysaccharides: Long chains of sugar molecules; glycogen (storage of glucose in animal) and starch (storage of glucose plants).

- Categories in Amylose& Amylopectin.

Dietary Fiber: human body cannot digest fully.
Soluble Fiber: Dissolves in water (gel-like substances).
Exp: Beans, Oats, Fruits.
Insoluble Fiber: Not able to dissolve in water.
Exp: Whole Grains, Vegetables, Nuts.

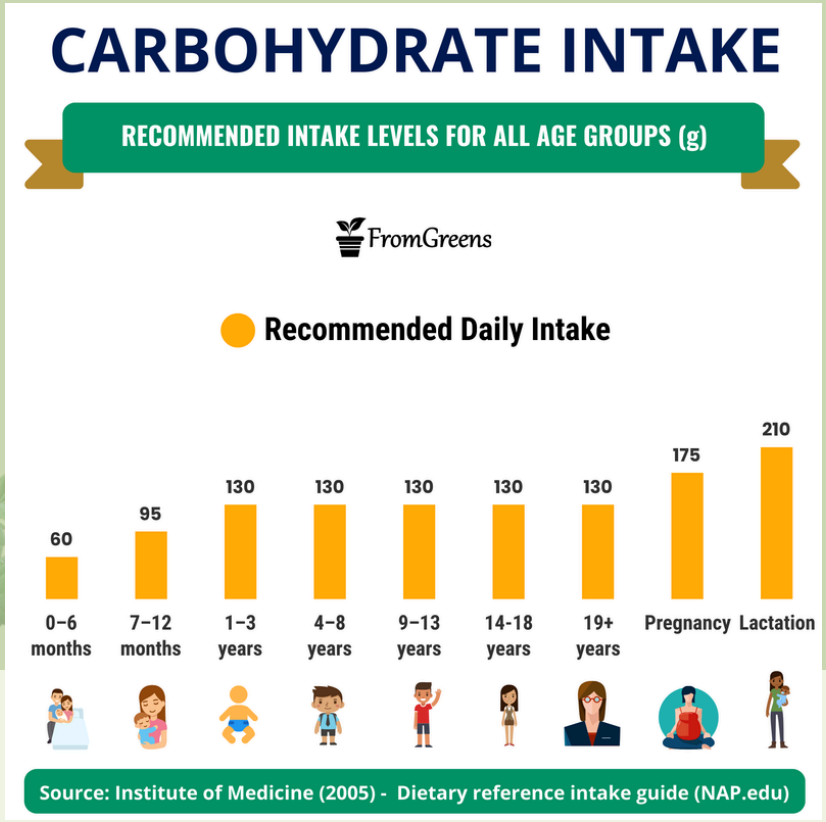
RECOMMENDED INTAKES (RDAs)

AMDR (Acceptable Macronutrient Distribution Range) is 45%-65%

§ Fiber intake for population below 50
38g for men , 25g for women

§ Fiber intake for population above 50:
30 for men, 21 for women

AI (Adequate Intake)



RDA's: an average of 130grams per day ; minimum needs for brains to function single day.

• FIBER TYPES, BENEFITS & CONSUMPTION

o **Fiber is a plant-based CHO source that our body cannot digest, there are soluble and insoluble fiber.**

o **Soluble Fiber** dissolve in water to form a gel-like substance for digestion.
o Helps in digestive system on softening and bulk up stool, prevent constipation. As well reducing LDL cholesterol level and reduce the risk of heart disease and stroke risks.

o **Insoluble Fiber** in contrast does not dissolve in water but remain the structure in digestion.
o Insoluble fiber also helps in gut bacteria, supporting diverse and healthy gut microbiota.

o Both soluble and insoluble fiber helps to prevent constipation and improve bowel movement.

Regulation of Blood Glucose

(start from mouth, stomach,small intestine and big intestine)

1. Digestion

Mouth

first digestion starts here, with enzyme salivary amylase (ptyalin), from complex CHO to simpler sugar.

"Carbohydrate provides 4 calories per grams"

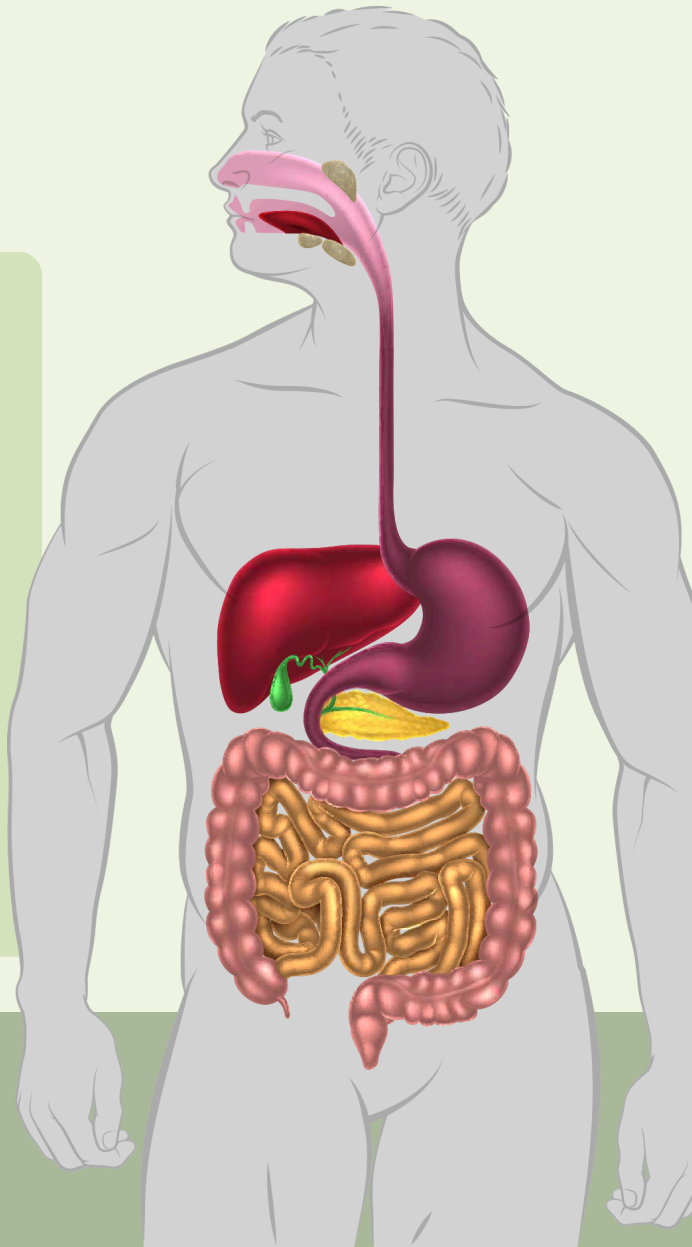
Stomach

·having Acid so CHO digestion temporality stops here and resume in small intestine.

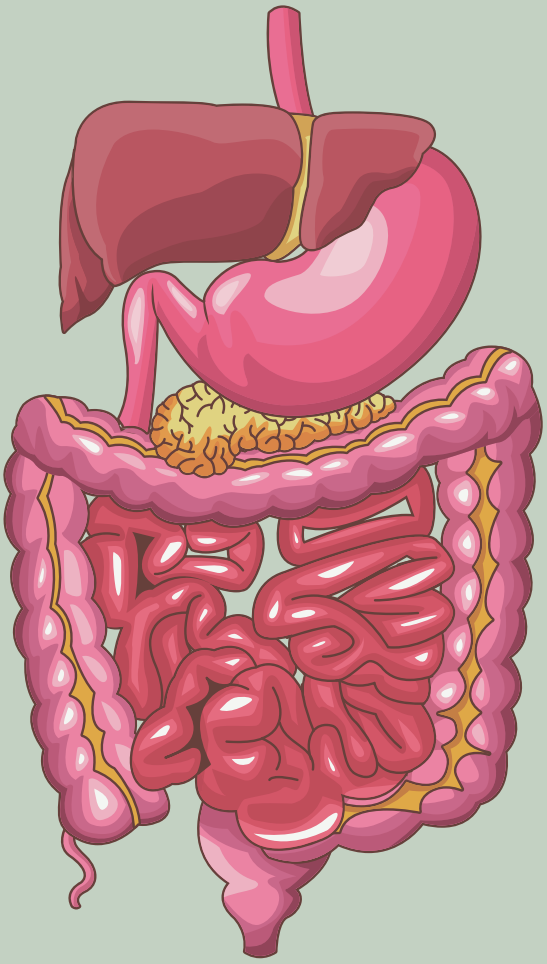
Small Intestine

Pancreatic secretes pancreatic amylase, enter small intestine through pancreatic duct.

- o Pancreatic amylase breakdown CHO into simpler sugar (Maltose, maltotrioses, alpha-dextrin's).
- o In Intestinal lumen: these oligosaccharides were hydrolyzed (by adding H2O) with enzyme alpha-dextrinase/ isomaltase / lactase / maltase)
- o While the final stage of CHO digestion, These enzyme; Maltase, Lactase, Sucrase and Alpha-Dextrinase associated with microvilli plasma membranes, break into monosaccharides and ready for absorption.



Regulation of Blood Glucose



2. Absorption

In duodenum and jejunum:

absorption started in villi and further lined with microvilli

- o In microvilli plasma membrane, monosaccharides transported across intestinal epithelial cells to cytoplasm of intestinal cells with specialized transport protein known as (GLUT2 for glucose / GLUT 5 for fructose)
- o Then monosaccharides have to transport to the bloodstream from cytoplasm of intestinal cells for providing energy and support metabolic regulation, monosaccharides transported across basolateral membrane facilitate by transporters such as GLUT 2 & GLUT 4.
- o Transporters GLUT 2 (passive transport) transport glucose to apical membrane of intestinal cells and moved from lumen into cells.
- o Then glucose can be actively transported across basolateral membrane pushed into blood stream via GLUT2 and GLUT 4.
- o While Fructose was transported via GLUT 5, metabolized to liver.
- o Galactose were transported via GLUT 2, metabolize to the liver.

3. Hormones

Insulin

Glucose Uptake: Insulin allow glucose to enter the the cells in muscle and adipose tissue, promote translocation of GLUT (transporter) . This facilitate glucose to uptake into cells membrane and formed as glycogen for later use.

Glycogen Storage: Insulin stimulates glucose into glycogen and store in liver and muscle, ready to be served as energy when bloodstream does not have enough glucose.

Inhibition of Gluconeogenesis: With aforementioned, insulin inhibit gluconeogenesis during fasting preventing excessive glucose production when low bloodgluxose level happen

Glucagon

o **Counterregulatory Hormone:** In opposition to insulin, glucagon ensuring that blood sugar levels do not drop too low between meals or during periods of increased energy expenditure.
o **Glycogenolysis:** Glucagon aid in the breakdown of glycogen which stored in the liver and muscles into glucose (glycogenolysis), then releases glucose into the bloodstream for use by cells.
o **Gluconeogenesis:** Glucagon stimulates gluconeogenesis, which the liver's production of glucose from precursors like lactate, amino acids, and glycerol. This is especially important during fasting periods when dietary glucose is not available.

Cortisol

Cortisol is also apart of stimulator of gluconeogenesis (liver).
o Also help in gluconeogenesis promotoes amino acid into the form ofglucose for energy use.

Epinephrine(Adrenaline)

o **Rapid Response:** Epinephrine is released to response an acute stress

o **Glycogenolysis:** It provide a quick surge of glucose for immediate energy needs, enhances the breakdown of glycogen in the liver and muscles.

Fight or Flight: Epinephrine prepare the body for a "fight or flight" response by increasing alertness, heart rate, and energy availability

• COMPARISON BETWEEN GLYCEMIC INDEX & GLYCEMIC LOAD

o Glycemic Index (GI):

§ Numeric Scale, rank CHO food on how quick to raise blood sugar level
§ Concern in Quality not quantity
§ Express in percentage/ score from 0-100 (GL values)
§ Low GI food (below 55) such as whole grain bread, lead slower effect on blood sugar; High GI food (above 70) such as white rice cause rapid increase in blood sugar
§ One limitation of just use GL for food selection might cause low GI food still to have significant impact of blood sugar level while consuming in large quantity.

o Glycemic Load (GL):

§ Calculate by multiplying GI by gram in per serving and divided by 100.
§ Concern in booth quality and quantity, have accurate picture of certain food
§ Low GL food (0-10), Moderate GL (11-19), high GL (20 and higher)

• BENEFICIAL INFORMATION RELATED TO CHRONIC DISEASES/CONDITIONS

Diabetes population:

- Understanding Carbohydrate types and be able to choose suitable carbohydrate source food is beneficial for long term health.
- Counting Carbohydrates needs and monitoring GL and GI food, would have smaller impact of blood sugar level.
- Rich in fiber choices by selecting varies of carbohydrate choices such as vegetables & food, grains, and legumes, mix and match during meals would help nutrient density and improve overall health benefits.

Colorectal Cancer

(A gut cancer)

- Consume foods high in fiber, help to feel satisfied and support digestive health. Aim to include fiber-rich foods in your meals.
- Some research suggest diets that lead to insulin resistance, often associated with high consumption of refined carbohydrates and added sugars, therefore choose whole grain options to help regulate digestionand absorption.

Heart Health Population:

- Balanced intake of carbohydrates, along with protein and healthy fats, can help control hunger and support weight management. High-fiber carbohydrates provide a feeling of fullness.
- Having whole grains into the diet, such as whole wheat, oats, and brown rice, can reduce the risk of heart disease.

Weight Management:

- Mindful Eating: Sometimes overeating can be happen at everymeal, p aying attention to hunger cues and eating slowly can help prevent overconsumption of carbohydrates and reduce the risk of weight gain and obesity-related conditions.
- Eat the rainbow with full of multiple grains, fruits and vegetables would be helpful to consume enough nutrients.

CITATION

Atrain education. 4. Regulation of Blood Glucose | ATrain Education. (n.d.). https://www.atrainceu.com/content/4-regulation-blood-glucose#:~:text=Regulation%20of%20blood%20glucose%20is,glucagon%2C%20somatostatin%2C%20and%20amylin.

Carbohydrate: Functions,deficiency symptoms ,vegan foods,daily intake. Fromgreens. (2021, October 7). https://fromgreens.com/carbohydrate-vegan-nutrition/

Current dietary guidelines. Dietary Guidelines for Americans, 2020-2025 and Online Materials | Dietary Guidelines for Americans. (n.d.). https://www.dietaryguidelines.gov/resources/2020-2025-dietary-guidelines-online-materials

The lowdown on glycemic index and Glycemic Load. Harvard Health. (2023, August 2). https://www.health.harvard.edu/diseases-and-conditions/the-lowdown-on-glycemic-index-and-glycemic-load#:~:text=Glycemic%20load%20diet&text=The%20total%20amount%20of%20carbohydrate,will%20happen%20to%20blood%20sugar.