What is in your burger?

RECIPE

Carbohydrates
Proteins
Fats
Vitamins
Minerals
Fibre
Water

Carbohydrates 1

Polysaccharide

Monomer: Monosaccharide
Main function: Immediate source of energy

Monosaccharides include:
galactose, glucose and fructose

Disaccharides include:
lactose (galactose + glucose)
sucrose (fructose + glucose)
maltose (glucose + glucose)

Excess:
Obesity, Type II diabetes, Fatty Liver, Dental cavities

Deficiency: Mental and physical fatigue, Weight loss (anorexia), muscle loss, constipation

Type II diabetes:

Type II diabetes (late-onset diabetes) occurs when there is a failure of the insulin receptor proteins on the cell surface membrane of target cells. Sugar builds up in bloodstream → more insulin produced, and eventually beta cells can become impaired. Common in people over 40 years, but young people are increasingly getting type II diabetes because of poor diet. Prevention and treatment by a healthier diet and regular physical exercise.

Polysaccharides include:

- Cellulose *(plant cell wall; fibre)*
- Amylose *(starch; energy storage for plants)*
- Amylopectin *(larger starch molecule; energy storage for plants)*
- Glycogen *(energy storage for animals; same linkages as amylopectin)*

Sources of Carbohydrates:



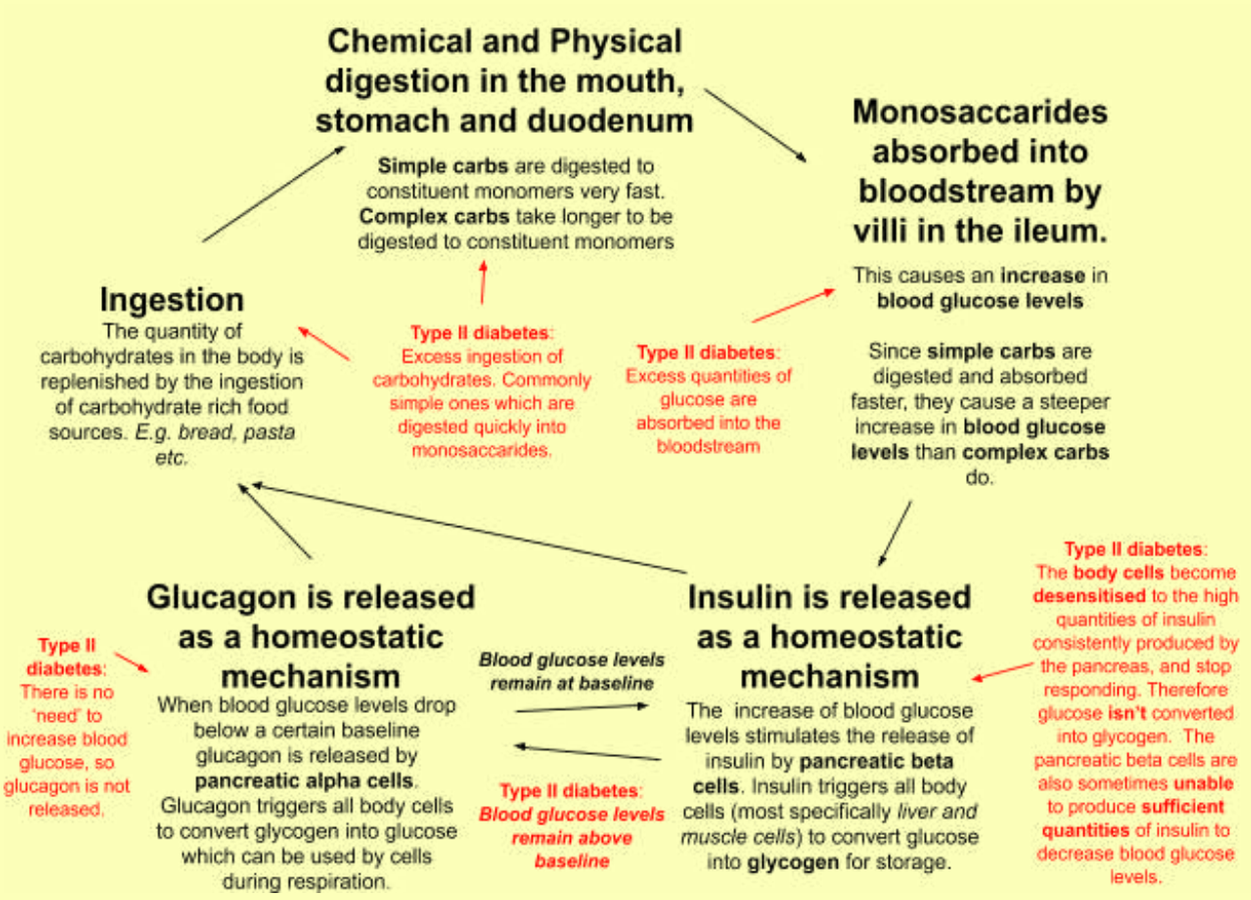
Carbohydrates 2

Complex vs **Simple** Carbohydrates:

Complex: Polysaccharides - often contain cellulose *(fibre)* and thus take a **longer time to digest**.
Examples: Rye bread, oats, whole grain, vegetables *(potatoes etc.)*

Simple: Di/Monosaccharides - made up of a smaller amount of monomers and thus take a **shorter time to digest**.
Examples: Honey, cane sugar, white bread, fruit juice etc.

***Refined carbohydrates** are created by processing **complex** carbohydrates and making them **simple** by removing components which contain polysaccaride parts *(ie. cellulose in the brown covering of rice)*



Carbohydrates 3

An individual may be intolerant to a carbohydrate if they don't possess the appropriate mechanisms to digest and absorb the given carbohydrate. This is also known as:

Malabsorption

Lactose Intolerance

Can be determined through a hydrogen/methane breath test

Before a hydrogen breath test - the patient is required to go on a specific diet for at least 24 hours

According to Healthline, 75% of the world is lactose intolerant

Helen West, RD (UK). (n.d.). *Lactose Intolerance 101 - Causes, Symptoms and Treatment*. Retrieved from https://www.healthline.com/nutrition/lactose-intolerance-101#section1

Lactose intolerance is caused by a lack of the enzyme **lactase** necessary to catalyse the hydrolysis of the disaccharide lactose *(present in dairy products).*

The undigested lactose in the small intestine causes osmosis into the lumen of the small intestine *this results in diarrhoea.*

The undigested lactose in the colon/large intestine is then digested by gut bacteria - the products of this metabolism are carbon dioxide, hydrogen and methane gas. This results in the common symptoms of *bloating, flatulence and abdominal pain*.

*** Individuals with Lactose intolerance may be able to eat lactose in small quantities, but this resistance is specific to each individual person.*

Foods with lactose which may be eaten in moderation:

Hard cheese
Butter
Feta cheese
Yogurt

According to Healthline, in general, a lactose intolerant person may be able to take 10g of lactose in one sitting. This may include milk in coffee/tea.

Halcium and elen West, RD (UK). (n.d.). Lactose Intolerance 101 - Causes, Symptoms and Treatment. Retrieved from https://www.healthline.com/nutrition/lactose-intolerance-101#section1

Common foods which contain lactose:

Dairy foods
Whey
Dry milk solids
Milk casein
Sour Cream

Helen West, RD (UK). (n.d.). Lactose Intolerance 101 - Causes, Symptoms and Treatment. Retrieved from https://www.healthline.com/nutrition/lactose-intolerance-101#section1

It is crucial that the individual attempt to obtain nutrients present in dairy products through other means. Some appropriate food alternatives are:

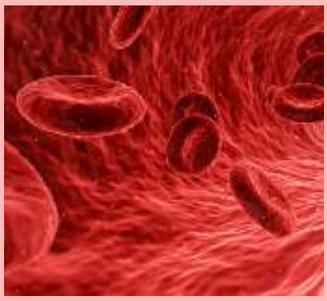
Dried figs
Kale
Broccoli
Soybean
Lactose-free milk
Tahini

H**alcium and** elen West, RD (UK). (n.d.). Lactose Intolerance 101 - Causes, Symptoms and Treatment. Retrieved from https://www.healthline.com/nutrition/lactose-intolerance-101#section1

Proteins 1

Polypeptide

Function:



- *Structure:* Spider silk, keratin
- *Hormones:* Glucagon + insulin
- *Immunity:* Immunoglobulin
- *Transport:* Haemoglobin
- *Sensitivity:* Rhodopsin
- *Movement:* Myosin, actin
- *Enzymes:* Amylase, maltase, pepsin

There are 22 amino acids in our body. The specific R group (variable group) in the molecule determines the specific function of the amino acid *(monomer of polypeptides)*

Animal:

Found in: Fish, cheese, red + white meat

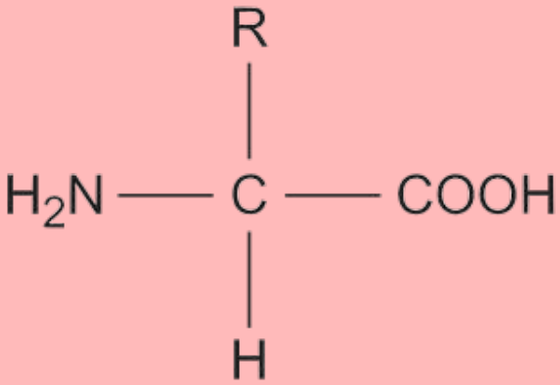
Complete sources of protein -- contain all the essential amino acids that the body needs to function properly

Vegetable:

Found in: Lentils, beans, tofu, quinoa

Incomplete sources of protein -- lack one or more essential amino acids that the body requires

Combined with grains: Provides a similar amount of amino acids as animal protein



Proteins 2

Synthetic:

An example is Protein powder:

Used for patients (e.g. stroke patients) and elderly with difficulty ingesting solid food, malnourished people and people with anorexia

E.g. Resource 2.0: drink which can replace a complete and balanced meal

Pros: Convenient, quick source of protein, easily digested, fast resource

Cons: Questionable ingredients (?), can be overused (inappropriately)

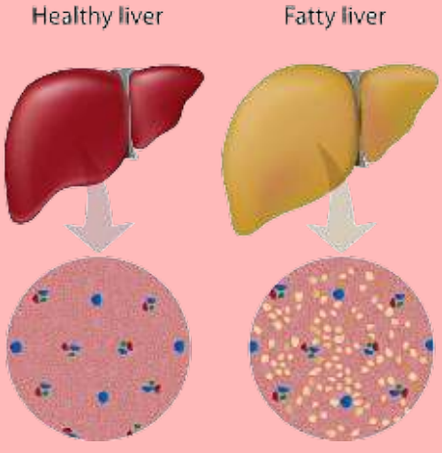
Excess: Weight gain, Ca loss in urine, dehydration, kidney and liver overload

Deficiency: Kwashiorkor, brittle skin, edema, increased risk of infections, fatty liver.

Kwashiorkor: a form of malnutrition caused by a lack of protein. The lack of protein causes an osmotic imbalance, causing swelling of the gut. Kwashiorkor can cause stunted growth and can be life-threatening. Treatment: introducing extra protein into the diet.

Fatty liver: Impaired synthesis of fat-transporting proteins due to lack of protein causes accumulation of fat in liver cells.

Prevention: A healthy diet and regular physical exercise



Fats

Lipids & Fatty Acids

Functions: Used in cell membrane (cholesterol decreases the flexibility of membrane + increases solubility of hydrophobic substances), long term energy source (takes up 1/4th the amount of space that glycogen does + is insoluble in water, does not affect osmolarity of blood + has a greater ATP yield)

Lipids are transported in the body by:

HDL *(high density lipoprotein)* = Good because transports cholesterol from the body to the liver for storage + excretion

LDL *(low density lipoprotein)* = Bad because transports cholesterol from liver to body

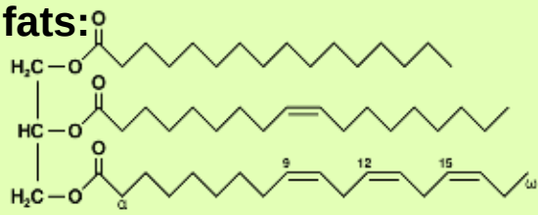
Different types of lipid molecules:

- **Saturated:** No double bonds
- **Monounsaturated:** One double bond
- **Polyunsaturated:** More than one double bonds

Saturated fats are bad because they are often created artificially through ***hydrogenation*** *in industry.*

Different type of unsaturated fats:

- **Cis:** Bend in the chain at the double bond
- **Trans:** No bend in the chain at the double bond

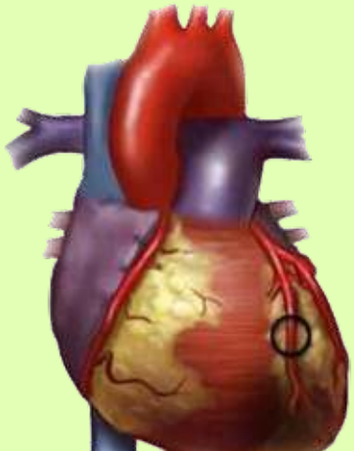


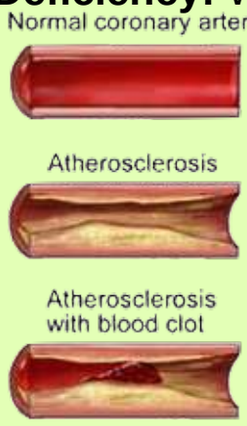
Excess: Weight gain, CHD, high blood cholesterol (increase in visceral fat + subcutaneous fat)

CHD: Coronary heart disease. Plaque (containing cholesterol) builds up in the coronary arteries, which supply heart cells with blood, oxygen and nutrients. The blockage decreases blood flow to the heart, causing chest pain and shortness of breath. A complete blockage could even lead to a heart attack.

Treatment: Healthy lifestyle, various drugs, angioplasty and stent placement, coronary artery bypass surgery

Deficiency: Weight loss, dull skin (bad skin),





Vitamins 1

There are many vitamins that our body need such as Vitamin A, B, C, D

Required in moderate and consistent amounts in the body

Vitamin A (*beta-cerotene*):

Usually found in fish liver oil. It is beneficial for eye health.

Excess *(Hypervitaminosis A):* Acute/chronic toxicity. Leads to changes in vision, bone pain and skin changes, possibly liver damage and pressure on brain**.**

Deficiency: Night blindness, rashes, impaired immunity and impaired hematopoiesis.

Treatement: Vitamin A supplements, diet of dark green leafy vegetables and brightly coloured fruits

Vitamin B:

There are two important sub-types of vitamin B: B12 & B9

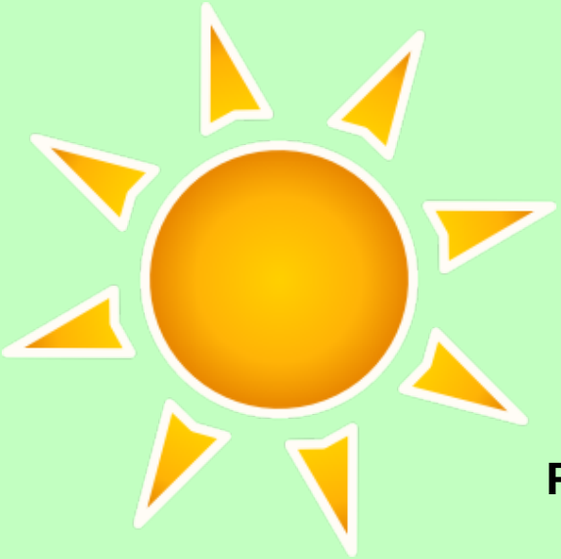
- **B12**: *Cobalamin* → Production of red blood cells, production of myelin (necessary for the myelinated transmission of action potential). Safe in **excess**. **Deficiency** leads to weakness and fatigue
  - Found in: *Fish, meat, poultry and eggs*

- B9: *Folic acid* → Used to treat anaemia, used to repair DNA and RNA as well as making red blood cells. **Excess** can lead to nerve damage, trouble sleeping at night, skin reactions and stomach problems. **Deficiency** leads to risk of clinical depression, problems with memory and brain function and long term risk of low bone density.
  - Found in: *Chickpeas, beans and lentils*

Vitamins 2

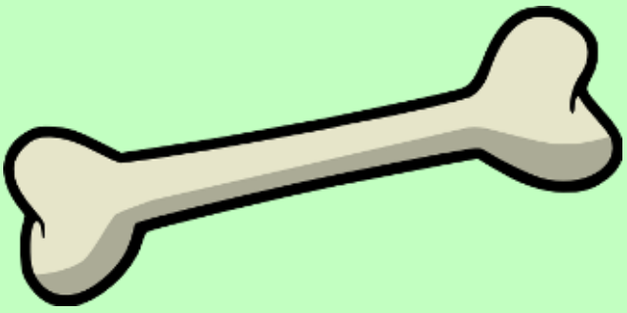
Vitamin C (*ascorbic acid*):
Usually found in citrus fruits and vegetables. It promotes healthy gums, production of neurotransmitters *(e.g acetylcholine),* repair of tissue. Vitamin C **increases** the **absorption** of **Iron**. **Acute excess** causes nausea and diarrhoea. **Deficiency** leads to *scurvy*.

Scurvy: Caused by a lack of vitamin C, which is needed to make collagen, an important component in connective tissue. Can lead to anemia and spontaneous bleeding.
Treatment: Taking vitamin C supplements



Vitamin D (*cholecalciferol*):
Can be obtained from exposure to sunlight (UV) or oral supplements as an alternative. Vitamin D is necessary for the absorption of calcium. **Excess** (*hypercalcemia*) causes nausea, vomiting, bone pain and kidney problems (*e.g Calcium stones*). **Deficiency** can lead to *osteoporosis, osteomalacia and rickets*.

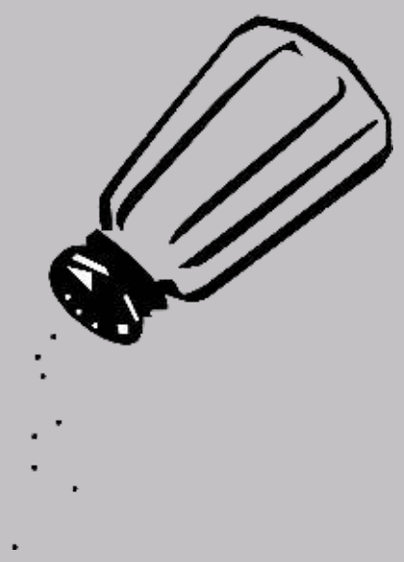
Rickets: Condition resulting in weak or soft bones in children which are prone to *deformity*. The body needs vitamin D to **absorb calcium** from the intestines. A lack of vitamin D will therefore cause a lack of calcium required to form bones.
Treatment: increasing intake of calcium, phosphates and vitamin D.



Minerals

There are many minerals that our body needs such as Iron, Calcium, Zinc, Sodium and Potassium

Required in small but consistent amounts in the body (are long lasting but consistently excreted)

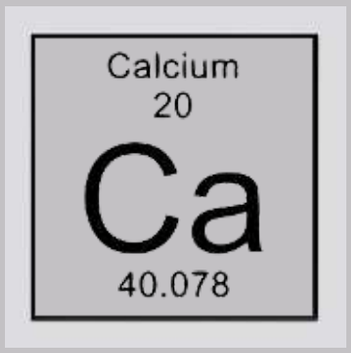


- **Sodium and Potassium:** *Used during the action potential (Na/K pump)*, *regulation of osmolarity in the body tissue (leading to the homeostasis of blood pressure), and regulation of pH of body tissue*

Found in: Bananas, table salt (NaCl)

Excess: Dehydration (caused by osmosis out of cells, causing **cell crenation**), increased risk of stroke, heart failure and stomach cancer

Deficiency: Weakened immune response, seizures

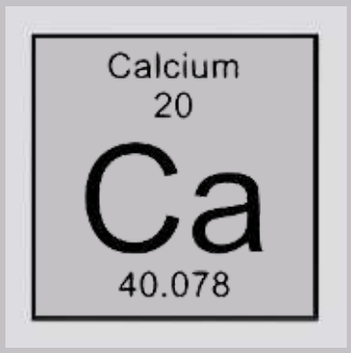
- 

  Calcium: *Strong bones and teeth*

  Found in: Dairy, meat

  Excess: Weakened bones, kidney stones, decrease in iron content

  Deficiency: Osteoporosis, osteomalacia and rickets



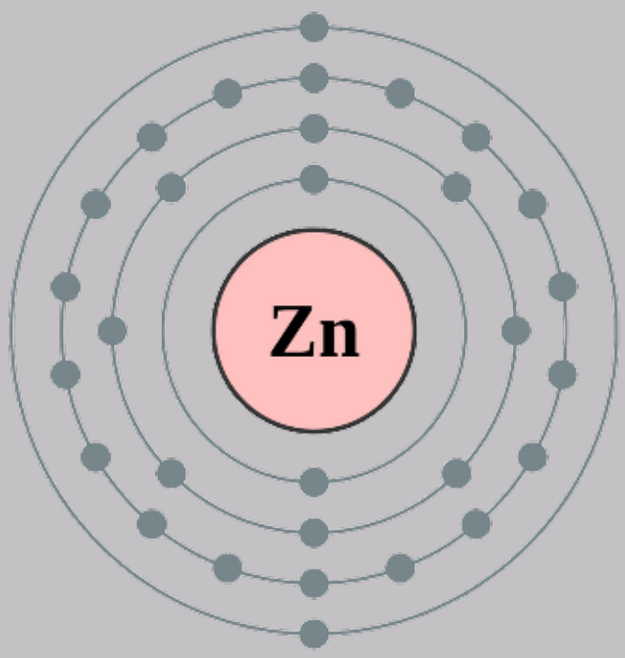
Osteoporosis: Bone disease, caused by porous bone. Body makes too little bone or loses too much bone. Bones become brittle as a result and easily break with little impact e.g. when sneezing.

Treatment: Taking calcium and vitamin D, other medicines. Deficiency in vitamin D can lead to osteoporosis as well.

Osteomalacia: Bone disease, caused by the softening of bones. The lack of calcium *(and/or Vitamin D)* prevents bones form mineralising properly. This causes soft bones which are susceptible to breaking and bending easily. The adult version of **rickets**.

Minerals

- **Zinc**: *Immune response*
Found in: Meat, seafood, oysters, beans, nuts
Excess: Suppresses immune system
Deficiency: low insulin



- **Iron:** production of Haemoglobin (Fe centre)
Found in: Red meat, kidney beans, fish, poultry
Excess: Chronic fatigue, joint pain, abdominal pain.
Deficiency: **Anaemia**, extreme fatigue, poor blood circulation, numbness in fingers and toes.

Anaemia: Lack of healthy red blood cells to carry oxygen to body cells. RBCs may have not enough haemoglobin (of which iron is an important part) and since haemoglobin carries oxygen in RBCs, iron deficiency can cause anaemia.
Treatment: iron supplements, increased intake of ***Vitamin C*** - which can be found in substances such as **lemon juice**, **pepper** and **various vegetables**.
Severe: intravenous iron therapy or blood transfusions.

Fibre and water

Not present in large amounts in the burger

Fibre (cellulose):

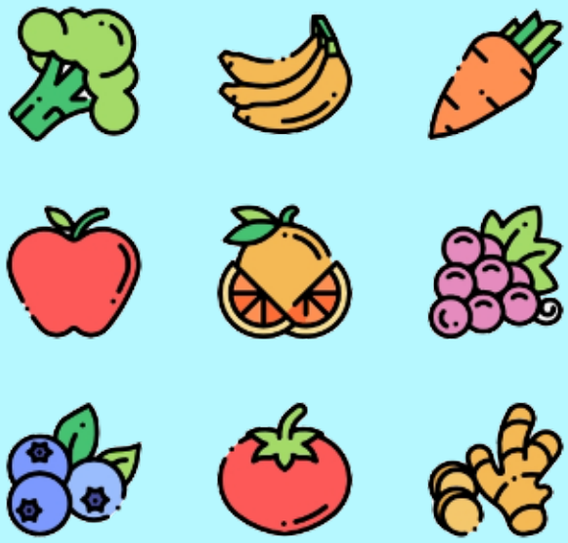
Indigestible by humans (fibre = cell walls)

Function: Healthy passage of stool and prevention of cancer

Excess: Bloating and release of a lot of gas, diarrhoea

Deficiency: Constipation

Found in: vegetables, fruits, cereal and grains (wholemeal)



Water:

Loss through urine, sweat, exhalation

Function: Hydration and osmoregulation of tissue

Excess: hallucination, osmosis into cell (lysis), hyponatremia, death in extreme cases

Deficiency: dehydration, lack of energy, fatigue, irritability, osmosis of water out of cells (crenation), constipation, death in extreme cases.

Hyponatremia: Low sodium concentration in the blood, causing headaches, nausea and seizures in severe cases. Caused by drinking excessive water, organ problems, SIADH (syndrome of inappropriate anti-diuretic hormone).

Treatment: drinking water in moderation, taking precautions during physical exercise.

Suggested Portion Size & Frequency of consumption 1

According to *Healthline,* an average man needs 2500 calories a day & an average women needs 2000 calories a day

Kris Gunnars, BSc. (n.d.). How Many Calories Should You Eat Per Day to Lose Weight? Retrieved from https://www.healthline.com/nutrition/how-many-calories-per-day#section1

However, recommended calorie intake is dependent on the individuals energy expenditure. Therefore, factors which affect a person's daily energy expenditure will affect their appropriate calorie intake

The amount of daily recommended calories is dependent on an individual's:

- *Body Mass Index*
- *Biological gender*
- *Physical activity level*
- *Health (whether they are recovering from a disease)*
- *Age*
- *Rate of metabolism*
- *Other niche requirements.*

Body Mass Index:

$$\frac{(weight\ in\ kg)}{(height\ in\ m)^2}$$

e.g a very tall muscular woman with an active lifestyle will require more calories per day than a short, un-muscular man with a sedentary lifestyle.

Table taken from WebMD, to show the recommended calorie intake (in KCal) for men/women at different ages and different activity levels - calculated for median height and weight values of the given demographic:

Gender	Age (years)	Sedentary[b]	Moderately Active[c]	Active[d]
Child	2-3	1,000	1,000-1,400	1,000-1,400
Female	4-8	1,200	1,400-1,600	1,400-1,800
	9-13	1,600	1,600-2,000	1,800-2,200
	14-18	1,800	2,000	2,400
	19-30	2,000	2,000-2,200	2,400
	31-50	1,800	2,000	2,200
	51+	1,600	1,800	2,000-2,200
Male	4-8	1,400	1,400-1,600	1,600-2,000
	9-13	1,800	1,800-2,200	2,000-2,600
	14-18	2,200	2,400-2,800	2,800-3,200
	19-30	2,400	2,600-2,800	3,000
	31-50	2,200	2,400-2,600	2,800-3,000
	51+	2,000	2,200-2,400	2,400-2,800

WebMD. (2005, November 1). How Many Calories Should You Eat? Retrieved from https://www.webmd.com/diet/features/estimated-calorie-requirement

Suggested Portion Size & Frequency of consumption 2

The recommended intake for each food group

	Female (age 19-30)	**Male** (age 19-30)	**Female** (age 31-50)	**Male** (age 31-50)
Calorie level(s) used	2,000	2,400/ 2,600/ 3,000	1,800	2,200
Protein, *% kcal*	10-35	10-35	10-35	10-35
Carbs, *% kcal*	45-65	45-65	45-65	45-65
Total fat, *% kcal*	20-35	20-35	20-35	20-35
Iron, *mg*	18	8	18	8
Magnesium, *mg*	310	400	320	420
Sodium, *mg*	2,300	2,300	2,300	2,300
Potassium, *mg*	4,700	4,700	4,700	4,700
Zinc, *mg*	8	11	8	11
Calcium, *mcg*	900	900	900	900
Vitamin A, *mg RAE*	700	900	700	900
Vitamin B_{12}, *mcg*	2.4	2.4	2.4	2.4
Vitamin C, *mg*	75	90	75	90
Vitamin D, *IU*	600	600	600	600
Dietary fibre, *g*	28	33.6	25.2	30.8

Appendix 7. Nutritional Goals for Age-Sex Groups Based on Dietary Reference Intakes and Dietary Guidelines Recommendations - 2015-2020 Dietary Guidelines. (n.d.). Retrieved from https://health.gov/dietaryguidelines/2015/guidelines/appendix-7/#table-a7-1

According to *OneMedical,* the recommended water intake *(including water from ingested food)* **for an average man is 3.7 litres** *(15 cups)* **and an average woman is 2.7 litres** *(11 cups)*

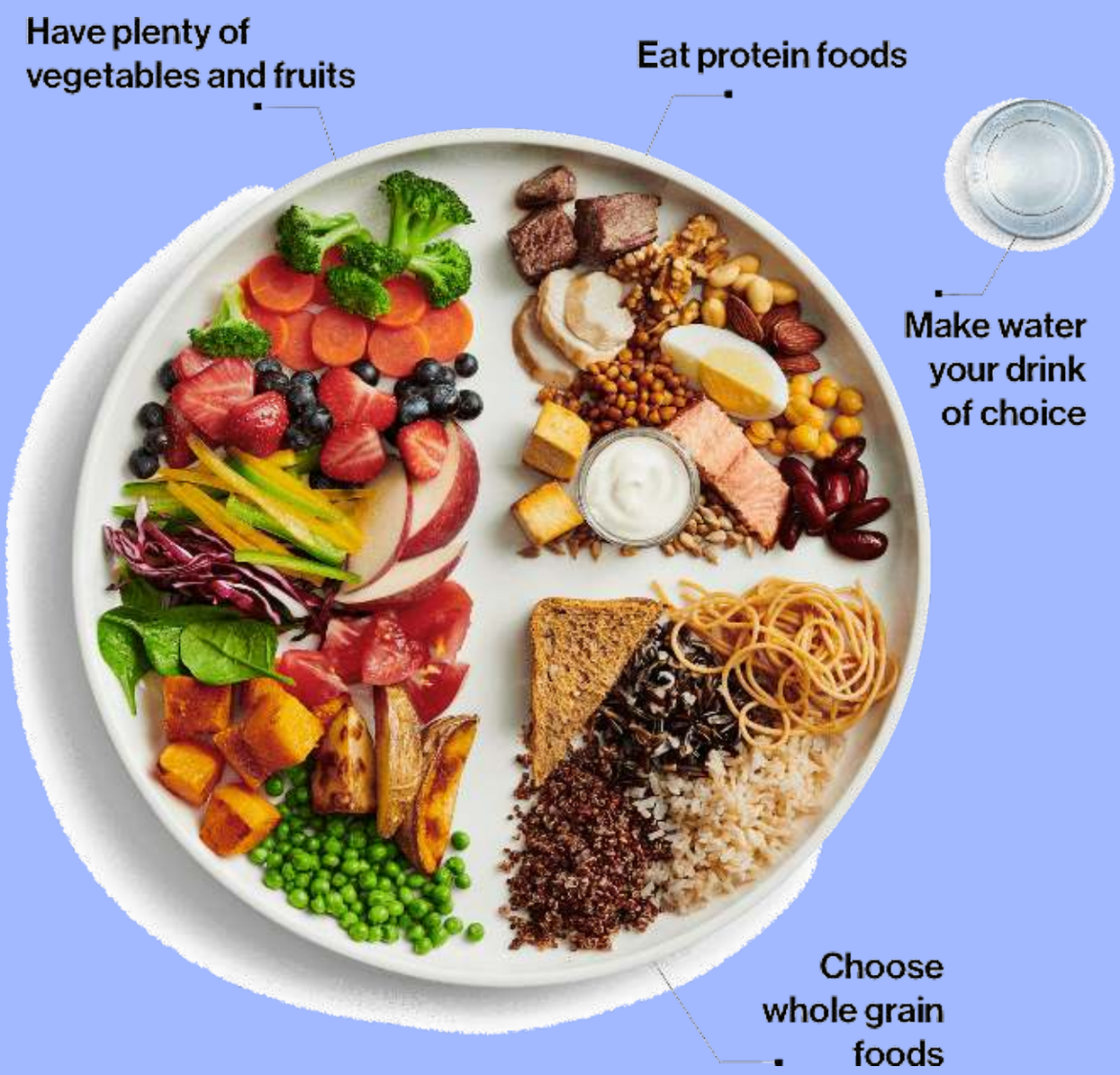
Kris Gunnars, BSc. (n.d.). How Many Calories Should You Eat Per Day to Lose Weight? Retrieved from https://www.healthline.com/nutrition/how-many-calories-per-day#section1

However, appropriate water consumption depends on the daily water loss of the individual, which is variable depending on:

- Quantity of urination
- Quantity of perspiration:

1. The temperature of the surrounding environment
2. The climate of the surrounding environment
3. Activity level
4. Genetic factors

Suggested Portion Size & Frequency of consumption 3



Rosenbloom, C. (2019, January 22). Canada's New Food Guide Is Here. Everything You Need To Know. Retrieved from https://www.chatelaine.com/health/canadas-new-food-guide/

Robinson, L., Segal Ph.D., J., & Segal M.A., R. (2019, June 20). Healthy Eating. Retrieved from https://www.helpguide.org/articles/healthy-eating/healthy-eating.htm

Studies 1

Type II diabetes

Aim: Review of the contributing factors of the Nurses' Health Studies in creating the hypotheses regarding the risk factors causing diabetes

Method: Narrative review of NHS + NHS II (1976 - 2016)

Results (according to records):
Excess obesity = strongest risk factor for development of type II diabetes
Central obesity (high WHR) associated w/ incidence of type II diabetes (regardless of BMI)
Duration of obesity: longer the individual = obese, greater likelihood that they will develop type II diabetes
Obesity + low physical activity = increase risk
Obesity = trigger (diathesis-stress) for development of pre-disposed type II diabetes risk

Nutrients:
Greater intake of trans fatty acids = greater risk of diabetes incidence
Replacing trans fatty acids/saturated fats w/ n-6 polyunsaturated fatty acids = lower risk
Diet rich in fibre = lower risk
High starch = higher risk
Higher intake of Mg + Zn = lower risk
Higher Fe intake = greater risk

Ley, S. H. ., Ardisson Korat, A. V. ., Qi Sun1, Tobias, D. K. ., Cuilin Zhang3, Lu Qi1, … Hu, F. B. 1. frank. hu@channing. harvard. ed. (2016). Contribution of the Nurses' Health Studies to Uncovering Risk Factors for Type 2 Diabetes: Diet, Lifestyle, Biomarkers, and Genetics. American Journal of Public Health, 106(9), 1624–1630. https://doi.org/10.2105/AJPH.2016.303314

Studies 2

Food:

Greater whole grains = lower risk (16% lower)
Greater intake of potatoes = higher risk
Frequent consumption of red meat (bacon, sausages, hot dogs) = higher risk
Nuts + low fat dairy = low risk
Green leafy veggies = lower risk
Fruits rich in anthocyanin → blueberries, apples grapes = lower risk
Yogurt = lower risk
Sugar sweetened beverages (SSB) = higher risk (regardless of body weight)
Regular coffee consumption = lower risk

Dietary patterns:

Higher intake of fruits + veggies, whole grains, legumes + lower intake of red meat, refined grains + SSB's = LOWER RISK
Skipping breakfast = higher risk (bc of higher BMI)
Consistently eating fried food = higher risk (bc of higher BMI)

Physical exercise:

moderate/high physical exercise = inversely proportional to incidence of type II (regardless of BMI)

Obesity (diet)

Aim: determination of the practices causing the incidence of obesity in children in Ho Chi Minh city
Method: In-depth interviews w/ students, parents, PE teachers + representative of dep. Of education. Data collected was cross-analysed to determine 'emerging themes'

Studies 3

Results:

obese children:

Irregular meal time

Meal skipping (breakfast)

Food sharing (skipping meals)

Limited involvement in choosing food and cooking at home

Abundance of fast food in school canteen

Unhealthy street food nearby

Snack and soft drink between meals

Low physical exercise

Obesity (sugar)

Method: Scrutinisation of data from randomised controlled trials + recent systematic reviews + meta-analyses relating to sugar consumption + negative health consequences.

Results:

Metabolism of fructose could result in increased likelihood of overconsumption of calories resulting in obesity

SSB's (sugar-sweetened beverages) associated w/ weight gain + obesity in children + adults (caused by increased energy consumption, not specific to metabolism of mono/disaccharides)

Approx. 94% of increased energy uptake in American individuals may be attributed to an increase in flour, cereal products + added fats (instead of SSB's)

Sugar + liver fat accumulation

Irregularly large doses of fructose may contribute to abnormal fat deposition in the liver

This may be caused by an overall increase in weight gain.

Little evidence for sugars (fructose) causing increase in liver fat accumulation because typically fructose is found in small amounts in food

Rippe, J., & Angelopoulos, T. (2016). Sugars, obesity, and cardiovascular disease: results from recent randomized control trials. European Journal of Nutrition, 55, 45–53

Nguyen, N.-M., Dibley, M. J., Tang, H. K., & Alam, A. (2017). Perceptions and Practices Related to Obesity in Adolescent Students and Their Programmatic Implications: Qualitative Evidence from Ho Chi Minh City, Vietnam. Maternal And Child Health Journal, 21(12), 2199–2208..