

Macronutrients - fats and proteins

Macronutrients are needed by the body in large amounts

PROTEINS

Large biomolecules built of amino acids bound together into long chains

15% of daily energy intake

Proteins have many functions in our bodies:

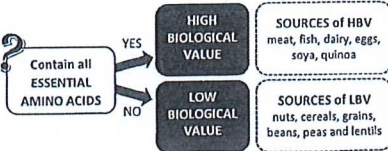
Functions

- Build enzymes and hormones
- Build cell membranes
- Repair and maintain tissues
- Defend the body (antibodies)
- Secondary source of energy

There are approximately 20 amino acids in total and each one has a specific function in our body. While most can be made by our bodies, approximately nine cannot – these have to be consumed through food.

- **Essential amino acids** – cannot be made by our bodies and need to come from food
- **Non-essential amino acids** – readily made by the body

Different foods contain different amounts of these essential amino acids. Foods that contain them all are called high biological value (HBV) and a protein source that lacks one of these essential amino acids is called a low biological value (LBV) protein.



You can obtain HBV proteins by combining two LBV proteins. This is called protein complementation.

Protein Complementation

A process of combining two or more LBV protein sources to obtain an HBV protein

Examples of protein complementation:
baked beans + bread
rice + peas
peanut butter + porridge oats

Too much or too little protein and the following can happen:

Excess	<ul style="list-style-type: none"> • Kidney and liver diseases • Weight gain
Deficiency	<ul style="list-style-type: none"> • Kwashiorkor • Slowing of growth rate • Swelling

What about vegetarians and vegans?

Protein Alternatives

Vegetarians and vegans don't consume meat so instead they use protein alternative products, which are manufactured in order to provide protein in a diet, and protein-rich plant foods.

Examples include:

- Mycoprotein (Quorn®)
- Tofu
- Tempeh
- Soy chunks
- Textured vegetable proteins (TVP)
- Beans, lentils, chickpeas



FATS

Large biomolecules built of one particle of glycerol and three particles of fatty acids that provide energy

35% of daily energy intake

The functions of fats include:

Functions

- Source of energy
- Insulation
- Dissolve vitamins
- Build hormones
- Build cell membranes

Omega 3
Polyunsaturated essential fatty acids present in fish, fish oil and cold-pressed vegetable oils

There are two types of fatty acid, outlined below:

Saturated

Contain only single bonds. Solid at room temperature.

Sources:

meat, cheese, butter, cream, whole milk, lard, suet, eggs

Unsaturated

Contain one or more double bonds. Liquid (oils) at room temperature.

Unsaturated fats (or fatty acids) can be divided into two further categories:

Monounsaturated

One double bond

Polysaturated

More than one double bond

Sources: fish and fish oil, vegetable oils and spreads, nuts and grains, avocados

Food can contain fat, even when you can't see it.

Visible



- Fats you can see – such as the fat on meat – are often saturated.
- However, visible fats can be unsaturated (such as oils in fish and from plants).
- Unsaturated fats you cannot see – such as those in nuts and avocados – are often good for the brain!
- However, some invisible unsaturated fats can be found in processed foods.

Invisible



Excess

- Obesity
- Hypertension
- Coronary heart disease
- Fatty liver disease
- Type 2 diabetes

Fats are needed, but so is a balance of them – too much fat or too little fat has consequences...

Deficiency

- Weight loss
- Vitamin deficiency
- Heart disease
- Feeling cold

Cholesterol

Fatty substance present in animal-origin foods, responsible for transporting fats around the body
Low-density lipoprotein (LDL) is 'bad' cholesterol
High-density lipoprotein (HDL) is 'good' cholesterol

Macronutrients - carbohydrates

CARBOHYDRATES

Large biomolecules built of carbon, oxygen and hydrogen, either in the form of simple, double or complex molecules built of hundreds of molecules of sugar bonded together

50% of daily energy intake

What do we need carbohydrates for?

Functions

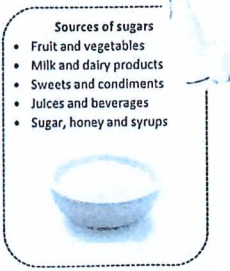
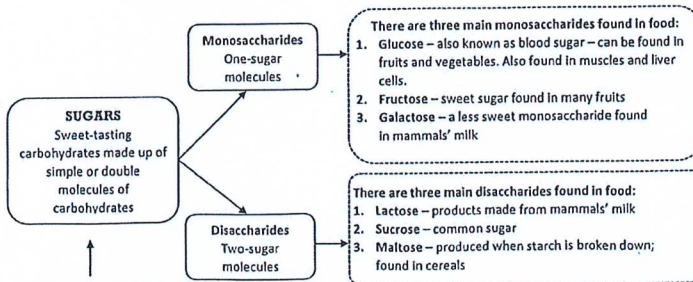
- Primary source of energy
- Store energy for later
- Build DNA
- 'Protein sparer'

Free sugar

Sugar that is added to foods, and the sugar naturally present in honey and fruit juices.
These should make up no more than 5% of your daily energy intake.

Intrinsic sugar

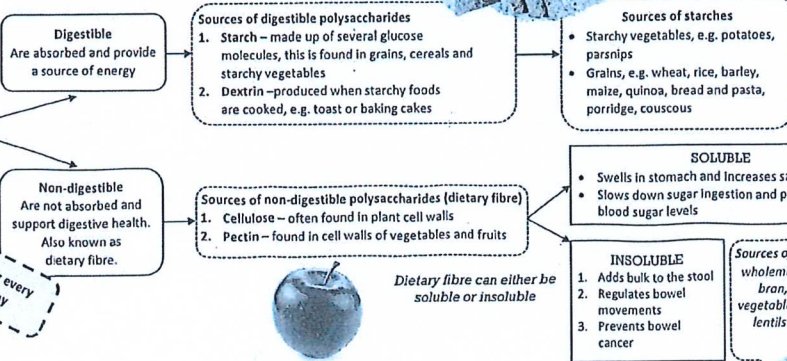
Sugar that is naturally present in fruit and vegetables.



There are two types of carbohydrates: sugars and complex carbohydrates known as polysaccharides, which are further broken down into subgroups.

POLYSACCHARIDES

Long chains of sugar bound together. Also known as complex carbohydrates.
Polysaccharides are either digestible or non-digestible.



What happens if you eat too many or too few carbohydrates?

Excess

- Tooth decay
- Type 2 diabetes
- Weight gain and obesity
- Hyperglycaemia

Deficiency

- Weight loss
- Lack of energy, tiredness
- Severe weakness
- Hypoglycaemia

- Hypoglycaemia – very low blood sugar level
 - o collapse/fainting, coma
- Hyperglycaemia – very high blood sugar level
 - o type 2 diabetes, damage to the nerves

What happens if you eat too much or too little fibre?

Excess

- Constipation or diarrhoea
- Impaired absorption of nutrients

Deficiency

- Constipation or diarrhoea
- Increased risk of obesity, type 2 diabetes, cardiovascular disease, bowel cancer

For more information, practice questions and activities, go to the online textbook.

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Micronutrients - vitamins

Micronutrients are needed by the body in small amounts

Water-soluble vitamins

Group B vitamins and vitamin C

Easily excreted from the body, usually non-toxic in excess, deficiency may be harmful

Fat-soluble vitamins

Vitamins A, D, E and K, present mainly in fatty foods, which can be stored in the body for long periods of time - excess may be harmful

A
Retinol

Functions:

- Growth and development of the body
- Helps support vision at night
- Keeps the skin and cell membranes healthy

Sources:

- Liver, milk and dairy, egg yolk, oily fish
- Red, yellow and green vegetables and fruit

Deficiency: night blindness, itchy and dry skin
Excess: toxic, harmful to unborn babies

D
Cholecalciferol

Functions:

- Healthy bones and teeth
- Helps absorb calcium

Sources:

- Produced in the skin in response to sunshine exposure
- Liver, milk and dairy, egg yolk, oily fish

Deficiency: rickets, osteoporosis, depression, increased risk of cancer
Excess: damage to the kidneys and other organs, weakened bones

E
Tocopherol

Functions:

- Helps growth of the baby during pregnancy
- Keeps cell membranes and muscles healthy
- Helps build sperm cells and red blood cells

Sources:

- Vegetable oils, seeds and nuts
- Egg yolk, wheatgerm

Deficiency: muscular dystrophy, anaemia, infertility
Excess: loss of appetite, nausea, flatulence, diarrhoea

K
Phylloquinone

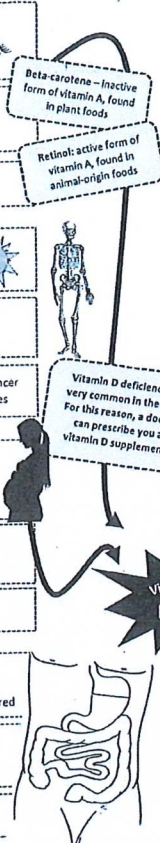
Functions:

- Ensures proper blood clotting and healing of wounds
- Prevents bleeding by supporting blood clotting when injured

Sources:

- Produced by gut bacteria
- Leafy green vegetables, green tea

Deficiency: bleeding, bruising
Excess: very rare, no known symptoms



	Function in the body	Source	Effects of deficiency and excess
Vitamin B1 Thiamine DRV 1 mg daily	<ul style="list-style-type: none"> Helps release energy from food Supports the nervous system 	<ul style="list-style-type: none"> Liver, milk and dairy Bread and cereals Eggs, nuts, peas 	<ul style="list-style-type: none"> Deficiency: beri-beri disease Excess: very rare
Vitamin B2 Riboflavin DRV 15 mg daily	<ul style="list-style-type: none"> Supports healthy skin, nerves and mucous membranes 	<ul style="list-style-type: none"> Chicken, eggs, milk and dairy Rice, bread, cereals, leafy vegetables, soya 	<ul style="list-style-type: none"> Deficiency: skin problems, dry lips, poor growth Excess: very rare
Vitamin B3 Niacin DRV 15 mg daily	<ul style="list-style-type: none"> Releases energy from carbohydrates Helps keep skin and nerves healthy 	<ul style="list-style-type: none"> Meat and poultry Cereals and grains Pulses (beans, lentils and other) 	<ul style="list-style-type: none"> Deficiency: pellagra, inflammation of skin, dementia (memory loss) Excess: damage of the liver
Vitamin B9 Folate / folic acid DRV 200 mcg daily	<ul style="list-style-type: none"> Ensures proper development of the nervous system Helps build red blood cells 	<ul style="list-style-type: none"> Bread and cereals Broccoli, Brussel sprouts, spinach Liver, chickpeas and peas 	<ul style="list-style-type: none"> Deficiency: spina bifida in newborns Excess: no known effects
Vitamin B12 Cobalamin DRV 1.5 mcg daily	<ul style="list-style-type: none"> Helps build red blood cells 	<ul style="list-style-type: none"> Meat, milk and dairy, egg yolk Fish and beef 	<ul style="list-style-type: none"> Deficiency: pernicious anaemia, more likely in vegans Excess: no known effects
Vitamin C Ascorbic acid DRV 40 mg daily	<ul style="list-style-type: none"> Builds connective tissues (such as skin and mucous membranes) Helps healing of wounds Increases absorption of iron 	<ul style="list-style-type: none"> Potatoes, tomatoes, Brussel sprouts Berries, currants Citrus fruit (lemon, orange, kiwi) 	<ul style="list-style-type: none"> Deficiency: scurvy, impaired healing Excess: stomach pain and diarrhoea

Antioxidants
Protect cells from the damage caused by free radicals.

Help prevent cardiovascular disease, cancer and maintain youth.

FREE RADICALS are particles of oxygen which have seven electrons and steal electrons from other particles in the body, causing damage and oxygen stress.

Sources of antioxidants:

- Fresh fruit and vegetables
- Nuts
- Whole grains
- Oily fish

How cooking affects nutritional value of food

Water-soluble vitamins can be lost by exposure to high temperatures, high pressure, oxygen and enzymes. Therefore, the following should be practised in order to reduce vitamin loss:

- Store foods out of direct sunlight
- Cut vegetables when you need them - so as not to expose to oxygen
- Boil vegetables for a short time when cooking them to reduce exposure to temperature and water
- Steam vegetables when possible
- Avoid damaged fruit and vegetables - bruised vegetables release enzymes that can reduce vitamin C.

Micronutrients (minerals)

Micronutrients are needed by the body in small amounts

Calcium (Ca)

- Works together with phosphorus and vitamin D to ensure proper bone and tooth health
- Helps blood clotting
- Ensures proper functioning of nerves and muscles

Excess: Excess is rare, but too much may lead to it being stored in the kidneys, stopping them from working.

Deficiency: Rickets - effect of calcium deficiency in children, in which bones don't grow properly and impair movement. Osteoporosis - effect of calcium deficiency in adults, in which bones become weak, brittle, easy-to-break and heal slowly.

Commonly found in milk and dairy products. Also present in nuts, bread and cereals, oily fish and green vegetables.

DRV: 700mg daily

Iron (Fe)

- Necessary for building red blood cells

Haem Iron (Easily absorbed by the body)
Red meat, offal, egg yolk

Non-haem Iron (Difficult to absorb)
Green leafy vegetables, dried fruit, chocolate, lentils

Haemoglobin - red pigment in the blood cells which carries oxygen around the body

Menstruation Part of the female monthly cycle when bleeding occurs

Excess: Stomach ache, Nausea, Vomiting, Constipation

Iron deficiency anaemia - symptoms include: pale complexion, tiredness, weak and split nails

Deficiency: Deficiency is usually caused by loss of blood, impaired absorption or genetic disorders.

DRV: 11 mg boys / 15 mg girls

Phosphorus (P)

- Works together with calcium and vitamin D to ensure proper bone and tooth health
- Essential for energy release

Excess: Tiredness, Depression

Deficiency: Decalcification of bones, Weak, brittle bones

Milk and dairy, Bread and cereals, Nuts, meat and fish

DRV: 550 mg

Iodine (I)

- Builds hormones in the thyroid gland
- Controls the rate of metabolism

Excess: Weight gain, change in metabolism

Deficiency: Swelling of the thyroid (goitre), Thyroid: small gland in the front of the neck

Red meat, sea fish, shellfish, cereals, grains, Nuts, meat and fish. May be breathed in at the seaside and in salt caves

DRV: 140 mcg daily

Fluoride (F)

- Builds and strengthens tooth enamel

Excess: Brittle tooth enamel, Tooth decay

Deficiency: Tooth decay / dental caries

Bony fish (e.g. sardines) and seafood, tea, toothpaste and mouthwash

Fluoride is also added to drinking water by fluoridation

DRV: 3.5 mg daily

Sodium (Na)

- Maintains body water balance
- Important for the conduction of nerve impulses

Excess: High blood pressure = hypertension, Heart failure and stroke, Kidney damage

Deficiency: Muscle cramps, Swelling of the body

Sources: Kitchen salt, Tinned foods (e.g. fish), Processed foods and fast foods, Salty snacks (e.g. crisps and nuts), Smoked and cured meats, bacon, cheese, Bread

DRV: 6.5 g of salt daily

Water

Water is LOST from the body by:

- Breathing - lungs, mouth and nose
- Body waste - kidneys and intestines
- Sweating - skin

This can lead to...

HEAT STROKE: Uncontrolled, life-threatening increase in body temperature

DEHYDRATION: A harmful reduction in water loss in the body

HYDRATION: Amount of water necessary for proper functioning of the body

Adults should drink around 2 litres of water a day!

Drink more:

- on hot, sunny days
- when you exercise a lot
- when you have a fever
- when you want to lose weight

Checklist for water benefits:

- Cools the body down and maintains stable body heat
- Helps digestion
- Removes toxins
- Eliminates waste
- Provides important minerals, such as calcium

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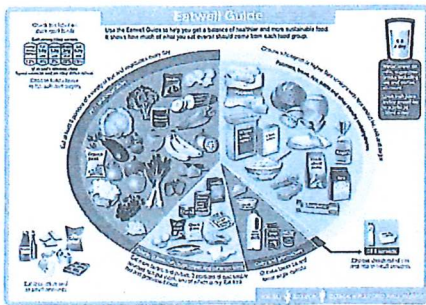
MAKING INFORMED CHOICES for a varied and balanced diet

Current Guidelines

Nutritional needs of people differ depending on:



However, general guidance can be taken from the Eatwell Guide (below).



Planning meals for specific dietary groups

Some people cannot, or do not want to, eat certain products. It is important to take that into account when planning a meal or diet for them.

Lactose intolerance

Common condition in which lactose cannot be digested, causing painful bloating, stomach pains and diarrhoea.

Lactose is a disaccharide present in milk.

Milk and dairy products should be avoided by lactose intolerant people.

Coeliac disease

- Inborn disease characterised by intolerance to gluten.
- Gluten intake causes inflammation and damage to the intestines, impairing nutrient absorption and leading to malnutrition.

Gluten is a protein found in wheat, rye, barley and oats.

A coeliac has to follow a gluten-free diet for their whole life.

Rice, potatoes, buckwheat and quinoa are gluten-free.

Vegetarians

People who do not eat meat and sometimes other foods of animal origin.

- Lacto-ovo vegetarians eat dairy and eggs
- Lacto-vegetarians eat dairy
- Ovo-vegetarians eat eggs
- Pesco-vegetarians eat fish

Vegans

People who do not eat any foods of animal origin, such as meat, fish, milk and dairy, eggs, honey and butter. Often avoid using other products of animal origin, such as leather clothing, fur, feathers, etc. All foods eaten are plant-based. Vegans are at risk of developing vitamin B12 deficiency and anaemia.

High-fibre diets

- Help prevent obesity, coronary heart disease, type 2 diabetes and some cancers
- Dietary fibre is a group of polysaccharides, usually indigestible for humans, present in the cell walls of plants
- Adults should eat 30 g of dietary fibre daily to remain healthy and prevent certain diseases

Soluble fibre:

- Increases satiety
- Slows down sugar ingestion and prevents type 2 diabetes

Insoluble fibre:

- Regulates bowel movements
- Prevents constipation
- Binds toxins and harmful substances
- Fibre-rich foods include: cereals, wholegrain products, raw vegetables

How nutritional needs vary depending on age

As we age, our nutritional needs change due to a number of reasons.

Young children

- Growth spurt means young children require more protein, calcium and vitamin D
- Teething means they require more calcium, fluoride and vitamin D
- More vitamins and minerals are needed to help support the developing immune system
- Fewer sugary sweets and drinks should be consumed to prevent overweight and tooth decay.

Teenagers

- Calcium and vitamin D should be consumed to support growth spurts and help reach bone mass
- Boys need more iron to prevent anaemia caused by menstruation
- Eat regularly to provide more energy for increased physical and intellectual activity
- Should consume fewer sweets and sugary drinks, do more physical activity and drink more water to prevent obesity and other health conditions

Adults and the elderly

- More dietary fibre should be consumed to prevent obesity, diabetes and cancers
- More vitamin D and calcium is required to maintain strong bones
- Fewer sugary snacks and drinks to prevent diabetes, coronary heart disease and obesity
- Elderly people are less active, so less energy is needed from energy dense foods
- More iron to prevent anaemia and maintain healthy red blood cells.
- Less salt and more water should be consumed, and more activity done, to reduce hypertension.

Portion size and costing when planning a meal

Eating the correct portion size can help ensure that an individual's nutritional and energy needs are met.

A portion is the amount of food eaten in one meal.

Planning meals and shopping in advance helps assess the cost and stay within the family budget.

Family budget is the amount of money allocated to spend on food or other goods.

Children may be using pester power to force their parents into buying sweets, toys or other things.

How to carry out nutritional analysis

Nutritional analysis allows you to measure the nutritional value of the food we eat. The following can be used to help you analyse foods:

- Food tables – contain data on all nutrients in a given food
- Nutritional analysis software – helps plan a meal and/or diet for specific target groups or plan a balanced diet.

This allows you to assess the needs of the consumer: their preferences, health conditions, age, etc.

Providing proper amounts of nutrients can help to improve and maintain health.

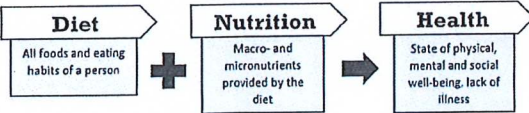
Modifying recipes

You can modify your recipes to make a given meal more suitable for different groups or individuals through a number of ways:

- Substitute ingredients, e.g. soy chunks for meat
- Reduce the amount of sugar, salt, fat or other ingredients
- Replace ingredients with low-fat, low-protein or high-fibre alternatives
- Choose low-fat dressings and sauces, e.g. yogurt instead of mayo
- Substitute saturated fats with unsaturated ones if possible
- Change the consistency of the dish

Diet, nutrition and health

Diet and nutrition have a large impact on health. An imbalanced diet may cause many diet-related diseases and conditions.



Name: Obesity

Condition in which fat is stored by the body in large amounts

Reasons:

- imbalanced diet
- lack of physical activity
- hormonal issues

Results:

- × increased risk of CHD
- × hypertension
- × stroke
- × diabetes
- × cancer
- × depression
- × social isolation
- × high cholesterol levels
- × infertility
- × back and joint pain

25% of adults and 16% of children in the UK are obese

Diet: balanced, varied, low-fat, low-sugar, regular meals during the day

Name: Coronary heart disease

Condition in which blood vessels in the heart are narrowed by cholesterol plaque build-up

Reasons:

- imbalanced diet
- too much cholesterol
- obesity
- hypertension
- smoking

Results:

- × cholesterol plaque build-up in the heart blood vessels
- × increased risk of heart attack
- × chest pains (angina)

CHD is the main cause of death in the UK

Diet: balanced, varied, low-fat to reduce weight, low-cholesterol

Name: Type 2 diabetes

Chronic condition in which blood sugar levels are abnormally high

Reasons:

- imbalanced diet
- obesity
- improper secretion of insulin*

Results:

- × damage to the nerves and blood vessels
- × eyesight loss
- × leg amputation
- × kidney failure
- × increased risk of heart attack and stroke

Diet: balanced, varied, regular meals, no simple sugars, usually low-fat to reduce weight

*Insulin – hormone produced in the pancreas, which lowers sugar levels in the blood by transporting sugar to the cells

Name: Hypertension

Condition in which blood pressure is too high (above 90/140 mmHg)

Reasons:

- imbalanced diet
- too much salt and cholesterol
- obesity
- impaired kidney performance
- smoking
- alcohol

Results:

- × cholesterol plaque builds up in the blood vessels (atherosclerosis) and increases the pressure, or liquids are not excreted properly from the body and the pressure rises
- × Hypertension increases the risk of heart failure, stroke and kidney disease

25% of adults in the UK suffer from hypertension

Diet: low in salt/sodium, usually low-fat to lose weight

Name: Iron deficiency anaemia

Condition caused by a lack of iron in the diet, or by impaired absorption in the gut

Reasons:

- iron is needed to build haemoglobin
- haemoglobin is the red pigment in the blood which binds oxygen and transports it around the body
- if there is not enough iron, red blood cells cannot be built and oxygen cannot be transported properly

Results:

- × pale skin
- × tiredness
- × shortness of breath
- × heart palpitations
- × dizziness
- × fainting
- × immune system is weakened and infections are more likely to occur

Diet: rich in iron and vitamin C, red meat, liver, eggs, broccoli, kale and spinach, beans and lentils, fortified cereals and bread

Vitamin C increases iron absorption in the gut!

Girls and women are at greater risk of developing iron deficiency anaemia

Name: Skeletal disorders

Group of diseases of the skeletal system caused by a deficiency of micronutrients

Reasons:

- lack of calcium
- lack of vitamin D
- lack of fluoride
- deficiency or excess of phosphorus
- excess sodium

Results:

- × Rickets
- × Osteoporosis
- × Tooth decay

Occurs in children

Bones become soft, don't grow properly, often become curved and make movement impossible

Occurs in the elderly

Bones become porous, brittle and easy to break, bones heal slowly after breaking

Is a result of calcium, vitamin D and fluoride deficiency, as well as a high-sugar diet and improper dental hygiene

Diet: high in calcium, vitamin D, fluoride, high in milk and dairy, fish and shellfish, low-sodium, low-sugar

Energy needs

Energy is the number of calories you need to consume every day to properly function and maintain your body mass. It varies for different people, depending on their sex, age, height, weight, occupation, lifestyle, body composition, etc.

Energy is measured in kilocalories (kcal) or kilojoules (kJ).

BMR (basal metabolic rate)

Amount of energy needed to stay alive, i.e. to keep the heart beating, to breathe and to maintain a stable body temperature.

Depends on: age, weight, height and sex

PAL (physical activity level)

Amount of energy needed to perform all life activities, e.g. cleaning, walking, shopping or swimming

1.0–1.4 – low PAL

1.5–1.8 – moderate PAL

Over 1.8 – active PAL

BMR × PAL = total energy expenditure (TEE)

(or how much energy a person needs each day)

BMI (body mass index)

Indicates whether a person's weight is proportionate to their height

$$\text{body mass in kg} \div \text{height in m}^2$$

BMI < 18.5 – underweight

BMI 18.5–25.0 – healthy

BMI 25.0–30.0 – overweight

BMI > 30.0 – obese

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