The Nutrition Fundamentals: Part Two

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THE NUTRITION FUNDAMENTALS

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MICRONUTRIENTS FUNCTIONS, TYPES, BENEFITS AND MORE

On top of the macronutrients (protein, fat and carbohydrates) we also consume a range of micronutrients (vitamins and minerals) in our diet.

Just as ‘macro’ was given to the term to suggest the majority, ‘micro’ is given to this set of nutrients to suggest a much lower quantity in the diet.

To show this, typically the macronutrients are measured in grams, where the micros are typically measured in milligrams However, it’s important to note that this is only related to quantity, asor micrograms (even smaller!). the micronutrients are also vital in terms of optimal body composition, health and performance.

Most vitamins and minerals are classified as essential, as the body cannot synthesize them on its own, so they must be obtained from the diet.

Despite their name they are vital for life.

Vitamins

Vitamins are potent, indispensable compounds that perform various bodily functions promoting growth, reproduction and maintain health. Essentially vitamins make people’s bodies work properly.

Although we receive these nutrients from most of the foods we eat, some foods have more vitamins and minerals than others. Most of the time, the micronutrients will be consumed within the macros we eat, as they are important within the metabolism of the macronutrients to produce energy. Also, many of the micronutrients are involved in endogenous antioxidant defense mechanisms, meaning they are involved in the oxidation-reduction balance of the body.

There are two classifications of vitamins: water-soluble and fat-soluble.

WATER-SOLUBLE VITAMINS

- Thiamin (vitamin B1)
- Riboflavin (vitamin B2)
- Niacin (vitamin B3)
- Pantothenic Acid (vitamin B5)
- Vitamin B6 (found in the body as pyridoxal, pyridoxine, pyridoxamine)
- Folic Acid (vitamin B9)
- Vitamin B12 (or cobalamin)
- Biotin (vitamin H)
- Vitamin C (ascorbic acid)

FAT-SOLUBLE VITAMINS

- Vitamin A
- Vitamin D
- Vitamin E
- Vitamin K

There are a number of key characteristics that separate the water-soluble and fat-soluble vitamins, these are shown below:

WATER-SOLUBLE VITAMINS

Dietary intake: Excess intake usually detected and excreted by the kidneys.

Body stores: Only a short-term supply available, with little storage, daily intake recommended.

Deficiency: Symptoms appear relatively quickly.

Toxicity: Lower risk of toxicity.

Absorption & transportation: Easily absorbed into blood and travel freely in blood.

Solubility: Dissolves in water

Stability in food and handling: Less stable.

FAT-SOLUBLE VITAMINS

Dietary intake: Excess intake tends to be stored in fat-storage sites.

Body stores: Long-term storage available in body tissues; regular intake recommended.

Deficiency: Symptoms are slow to develop.

Toxicity: Higher risk of toxicity.

Absorption & transportation: Like lipids, absorbed into lymph, many require protein carriers if they are to travel in the blood.

Solubility: Dissolves in lipid.

Stability in food and handling: Stable.

Summarizing this information, the vitamins have 3 key characteristics:

1. **They are all-natural compounds found in food.**
2. **They are essential nutrients to the body for physiological functions such as growth, repair, protection and reproduction etc.**
3. **Deficiency can occur when consumed in reduced or limited amounts.**

Over the last decade scientists have investigated the possibility that large doses of certain vitamins and minerals will help stave off chronic diseases such as cancer and heart disease, which rank as major killers today.

In fact, the study of vitamins, particularly a class known as the 'antioxidant vitamins', is one of the most widely published areas in current nutrition research.

What we do know is that where there is a deficiency of micronutrients, athletic performance in addition to normal physiologic function will suffer.

It's important to be aware of and understand the steady stream of controversial and other claims regarding vitamins, so below we will look at their roles, key sources, deficiency and toxicity symptoms and how we can incorporate this information into potential advice for our clients.

A Guide To Water-Soluble Vitamins

THIAMIN

Best sources: Meat, pork, liver, fish, poultry, whole grain and enriched breads, cereals and grain products, nuts & legumes.

Chief roles: Helps enzymes release energy from carbohydrates – supports normal appetite and nervous system function.

Deficiency symptoms: Beriberi: oedema, heart irregularity, mental confusion, muscle weakness, apathy, impaired growth.

Toxicity symptoms: None reported.

Research: Theoretically, thiamin supplementation could increase aerobic performance given that it is required for energy production in the Krebs cycle and pentose phosphate pathway. Deficiency in this vitamin is uncommon and research does not show a direct increase in aerobic or strength performance with further supplementation. (1)

RIBOFLAVIN

Best sources: Milk, leafy greens, yogurt, cottage cheese, liver, meat, whole grain or enriched breads, cereals and grain products.

Chief roles: Helps enzymes release energy from carbohydrates, fat and protein – promotes healthy skin and normal vision.

Deficiency symptoms: Eye problems, skin disorders around nose and mouth, magenta tongue, hypersensitivity to light.

Toxicity symptoms: None reported.

Research: Overall, riboflavin can function as an antioxidant, however deficiencies are not common and supplementation does not improve aerobic performance (2).

NIACIN

Best sources: Meat, eggs, poultry, fish, milk, whole grain and enriched breads, cereals and grain products, nuts, legumes and peanuts.

Chief roles: Helps enzymes release energy from carbohydrates, fat and protein – promotes healthy skin, nerves and digestive system.

Deficiency symptoms: Pellagra – flaky skin rash on parts exposed to sun, loss of appetite, dizziness, weakness, irritability, fatigue, mental confusion, indigestion, delirium.

Toxicity symptoms: Flushing, nausea, headaches, cramps, ulcer irritation, heartburn, abnormal liver function, rapid heartbeat with doses above 500mg per day.

Research: The attenuated release of free fatty acids and carbohydrate oxidation could result in an increase in aerobic performance, however this has not been scientifically proven. (3)

VITAMIN B6

Best sources: Meat, poultry, fish, shellfish, legumes, fruits, soy products, whole grain products, green leafy vegetables.

Chief roles: Protein and fat metabolism – formation of antibodies and red blood cells – helps convert tryptophan to niacin.

Deficiency symptoms: Nervous disorders, skin rash, muscle weakness, anemia, convulsions, kidney stones.

Toxicity symptoms: Depression, fatigue, irritability, headaches, numbness, damage to nerves, difficulty walking.

Research: Supplementation with Vitamin B6 may increase the use of muscle glycogen and a decrease in free fatty acids, however supplementation does not seem to improve aerobic performance. (4)

FOLATE

Best sources: Green leafy vegetables, liver, legumes, seeds, citrus fruits, melons, enriched breads, cereals and grain products.

Chief roles: Red blood cell formation – protein metabolism – new cell division.

Deficiency symptoms: Anemia, heartburn, diarrhea, depression, poor growth, neural tube defects, increased risk of heart disease, stroke and certain cancers.

Toxicity symptoms: Diarrhea, insomnia, irritability, may mask a vitamin B12 deficiency.

Research: The recommended daily allowance for folate should be sufficient and no research currently supports extra supplementation to improve athletic performance. (5)

VITAMIN B12

Best sources: Animal products – meat, fish, poultry, shellfish, milk, cheese, eggs, fortified cereals.

Chief roles: Helps maintain nerve cells – red blood cell formation – synthesis of genetic material.

Deficiency symptoms: Anemia, fatigue, and nerve degeneration progressing to paralysis.

Toxicity symptoms: None reported.

Research: The recommended daily allowance for vitamin B12 should be sufficient and no research currently supports extra supplementation to improve athletic performance. (6)

PANTOTHENIC ACID

Best sources: Widespread in foods.

Chief roles: Coenzyme in energy metabolism.

Deficiency symptoms: Rare – sleep disturbances – nausea – fatigue.

Toxicity symptoms: None reported.

Research: The recommended daily allowance for pantothenic acid should be sufficient and no research currently supports extra supplementation to improve athletic performance. (7)

BIOTIN

Best sources: Widespread in foods.

Chief roles: Coenzyme in energy metabolism and fat synthesis.

Deficiency symptoms: Loss of appetite, nausea, depression, muscle pain.

Toxicity symptoms: None reported.

Research: Studies have not been conducted to date on the effects of biotin alone and its effect on athletic performance. (8)

VITAMIN C

Best sources: Citrus fruits, cabbage-type vegetables, tomatoes, potatoes, dark green vegetables, peppers, lettuce, strawberries, mangoes, papayas.

Chief roles: Synthesis of collagen (helps heal wounds, maintains bone and teeth, strengthens blood vessel walls), antioxidant, strengthens resistance to infection, helps body absorb iron.

Deficiency symptoms: Scurvy – anemia, depression, frequent infections, bleeding gums, loosened teeth, pinpoint hemorrhages, muscle degeneration, rough skin, bone fragility, poor wound healing.

Toxicity symptoms: Intakes of more than 1g per day may cause nausea, abdominal cramps, diarrhea and increased risk for kidney stones.

Research: Vitamin C supplementation has resulted in improvements in exercise-induced damage, providing you meet the recommended daily allowance. It has not been shown to increase athletic performance and taking above the RDA may actually act as a pro-oxidant, thus inducing further damage. (9)

A Guide To Water-Soluble Vitamins

VITAMIN A

Best sources: Retinol – fortified milk and margarine, cream, cheese, butter, eggs and liver. Beta-carotene – spinach, broccoli, deep orange fruits (apricots, peaches, cantaloupe), and vegetables (squash, carrots, sweet potatoes, pumpkin).

Chief roles: Vision – growth and repair of body tissues – maintenance of mucous membranes, reproduction – bone and tooth formation, immunity – hormone synthesis, antioxidant.

Deficiency symptoms: Night blindness, rough skin, susceptibility to infection, impaired bone growth, abnormal tooth and jaw alignment, eye problems leading to blindness, impaired growth.

Toxicity symptoms: Red blood cell breakage, nosebleeds, abdominal cramps, nausea, diarrhea, weight loss, blurred vision, loss of appetite, bone pain dry skin, rashes, hair loss, cessation of menstruation, liver disease, birth defects.

Research: The recommended daily allowance for vitamin A should be sufficient and no research currently supports extra supplementation to improve athletic performance. (11)

VITAMIN D

Best sources: Self-synthesis with sunlight – fortified milk, fortified margarine, eggs, liver, fish, supplements.

Chief roles: Calcium and phosphorus metabolism (bone and tooth formation), aids the body's absorption of calcium.

Deficiency symptoms: Rickets in children, osteomalacia in adults, abnormal growth, joint pain and soft bones.

Toxicity symptoms: Deposits of calcium in organs such as kidneys, liver, or heart, mental retardation, abnormal bone growth.

Research: The latest research appears to show that many of us may in fact be deficient in this vitamin, thus making supplementation a good option. This is especially important in European countries with long winters and extended periods of darkness. See www.vitamindcouncil.org for more information.

VITAMIN E

Best sources: Vegetable oils, green leafy vegetables, wheat germ, whole grain products, liver, egg yolks, salad dressings, nuts, seeds.

Chief roles: Vision – Protects red blood cells, antioxidant, stabilization of cell membranes.

Deficiency symptoms: Muscle wasting, weakness, red blood cell breakage, anemia, hemorrhaging.

Toxicity symptoms: Doses over 800IU/day may increase bleeding (blood clotting time).

Research: The recommended daily allowance for vitamin E should be sufficient and no research currently supports extra supplementation to improve athletic performance. (12)

VITAMIN K

Best sources: Bacterial synthesis in digestive tract, liver, green leafy and cabbage-type vegetables, soybeans, milk, vegetable oils.

Chief roles: Synthesis of blood clotting proteins that regulates blood calcium.

Deficiency symptoms: Hemorrhaging, decreased calcium in bones.

Toxicity symptoms: Interference with anti-clotting medication, synthetic forms may cause jaundice.

Research: The latest research appears to show that many of us would in fact be deficient in this vitamin, thus making supplementation a good option.

A Guide To Minerals

TRACE MINERALS:

IODINE

Best sources*:* Iodized salt, seafood, bread.

Chief roles: Part element of hormone thyroxin, which regulates metabolism.

Deficiency symptoms: Goiter, cretinism;

Toxicity symptoms: Depressed thyroid activity.

Research: The recommended daily allowance for iodine should be sufficient and no research currently supports extra supplementation to improve athletic performance. (13)

IRON

Best sources: Red meats, fish, poultry, shellfish, eggs, legumes, dried fruits, fortified cereals.

Chief roles: Hemoglobin formation –part of myoglobin, energy utilization.

Deficiency symptoms: Anemia, reduced immunity, inability to concentrate, cold intolerance.

Toxicity symptoms: Iron overload – infections, liver injury, acidosis, shock.

Research: Clients with low iron levels are recommended to supplement with the RDA to seek improved athletic performance (14).

ZINC

Best sources: Protein containing foods, meats, fish, shellfish, poultry, grains, and vegetables.

Chief roles: Part of insulin and many enzymes involved in making genetic material and proteins, immunity, vitamin A transport, taste, wound healing, making sperm, fetal development.

Deficiency symptoms: Growth failure in children, delayed development of sexual organs, loss of taste, poor wound healing.

Toxicity symptoms: Fever, nausea, vomiting, diarrhea, kidney failure.

Research: Zinc is not usually a concern for non-athletes, but is excreted in higher amounts when a person sweats to a higher degree. In instances of high mineral excretion from sweating, zinc supplementation would be useful.

COPPER

Best sources: Meats, seafoods, nuts, drinking water.

Chief roles: Helps make hemoglobin, part of several enzymes.

Deficiency symptoms: Anemia, bone changes.

Toxicity symptoms: Nausea, vomiting, diarrhea.

Research: The recommended daily allowance for copper should be sufficient and no research currently supports extra supplementation to improve athletic performance. (14)

FLUORIDE

Best sources: Drinking water (if added), tea, seafood.

Chief roles: Formation of bones and teeth, helps make teeth resistant to decay.

Deficiency symptoms: Susceptibility to tooth decay.

Toxicity symptoms: Fluorosis (discoloring of teeth), nausea, vomiting.

Research: The recommended daily allowance for fluoride should be sufficient and no research currently supports extra supplementation to improve athletic performance. (14)

SELENIUM

Best sources: Seafood, meats, grains, vegetables.

Chief roles: Helps protect body compounds from oxidation, works with vitamin E.

Deficiency symptoms: Fragile red blood cells, cataracts, growth failure, heart damage.

Toxicity symptoms: Nausea, abdominal pain, nail and hair changes, liver and nerve damage.

Research: The recommended daily allowance for selenium should be sufficient and no research currently supports extra supplementation to improve athletic performance. (15)

CHROMIUM

Best sources: Meats, unrefined foods, vegetable oils.

Chief roles: Associated with insulin needed for release of energy from glucose.

Deficiency symptoms: Abnormal glucose metabolism.

Toxicity symptoms: Occupational exposures damage skin and kidneys.

Research: The recommended daily allowance for chromium should be sufficient and no research currently supports extra supplementation to improve athletic performance. (16)

MOLYBDENUM

Best sources: Legumes, cereals, and organ meats e.g. liver, kidneys.

Chief roles: In conjunction with enzymes, facilitates many cell processes.

Deficiency symptoms: Unknown

Toxicity symptoms: Enzyme inhibition.

Research: The recommended daily allowance for molybdenum should be sufficient and no research currently supports extra supplementation to improve athletic performance. (17)

MANGANESE

Best sources: Widely distributed in foods.

Chief roles: In conjunction with enzymes, facilitates many cell processes.

Deficiency symptoms: Unknown

Toxicity symptoms: Poisoning, nervous system disorders.

Research: The recommended daily allowance for manganese should be sufficient and no research currently supports extra supplementation to improve athletic performance. (18)

MAJOR MINERALS:

CALCIUM

Best sources: Milk and milk products.

Chief roles: Principal mineral of bones and teeth, involved in muscle contraction and relaxation, nerve function, blood clotting, blood pressure.

Deficiency symptoms: Stunted growth in children, bone loss in adults.

Toxicity symptoms: Excess calcium is usually excreted.

Research: Calcium is not an ergogenic aid, but supplementation should be used to prevent osteoporosis if there is a deficiency. (19)

PHOSPHORUS

Best sources: Meat, poultry, fish, dairy, soft drinks, processed foods.

Chief roles: Part of every cell, mineralization of bones and teeth involved in buffer systems that maintain acid base balance, used in energy metabolism.

Deficiency symptoms: Muscle weakness and bone pain.

Toxicity symptoms: May cause calcium excretion, calcium deposits in soft tissues.

Research: The recommended daily allowance for phosphorus should be sufficient and no research currently supports extra supplementation to improve athletic performance. (20)

MAGNESIUM

Best sources: Nuts, legumes, whole grains, green vegetables, seafoods, cocoa.

Chief roles: Involved in bone mineralization, protein synthesis, enzyme action, normal muscular contraction, nerve transmission.

Deficiency symptoms: Weakness, confusion, depressed pancreatic hormone secretion, growth failure, muscle spasms.

Toxicity symptoms: Excess intake has caused low blood pressure, lack of co-ordination, coma and even death.

Research: Magnesium does not have a really good single food source aside from some nuts. If most of your food is from nuts then you are not likely to be deficient in this mineral, however if not, then supplementation is a good option.

SODIUM

Best sources: Processed foods, whole grains, legumes, nuts, seeds.

Chief roles: Sodium is a mineral that carries an electrical charge, known as an electrolyte, which facilitates muscle contractions and nerve cell transmission.

Deficiency symptoms: Low blood sodium typically results from increased fluid retention. One may notice nausea, vomiting, headache, cramps, fatigue and disorientation.

Toxicity symptoms: Excessive intake can lead to increased fluid volume, nausea, vomiting, diarrhea and abdominal cramps.

Research: The recommended daily allowance for sodium should be sufficient and no research currently supports extra supplementation to improve athletic performance. (21)

POTASSIUM

Best sources: Sweet potato, tomato, green vegetables, carrots, prunes, beans, molasses, squash, fish, fruits.

Chief roles: Is essential for maintaining proper fluid balance, nerve impulse function, muscle function, and cardiac function.

Deficiency symptoms: Caused by protein wasting conditions. Diuretics can also cause excessive loss of potassium in the urine. Low potassium can result in cardiac arrest.

Toxicity symptoms: Occurs when the intake of potassium exceeds the kidneys' capacity for elimination. Found with kidney failure and potassium sparing diuretics. Symptoms include muscle weakness, nausea, vomiting and diarrhea.

Research: The recommended daily allowance for potassium should be sufficient and no research currently supports extra supplementation to improve athletic performance. (22)

Recommended Daily Allowances (RDA)

The below table shows the recommended daily allowances of vitamins and selected minerals for young adults.

RDA's are set to meet the needs of 97-98% of individuals. There can be small differences in these depending on sex, and upper limits (UL) have been suggested to highlight the maximum amounts that are not likely to cause adverse effects. No data (ND) exists to support the suggested upper limits.

NUTRIENT	RDA -MEN	RDA - WOMEN	UL
Thiamin (mg/d)	1.2	ND	1.1
Riboflavin (mg/d)	1.3	ND	1.1
Niacin (mg/d)	16	35	14
Pantothenic acid (mg/d)	5	ND	5
Vitmain B6 (mg/d)	1.3	100	1.3
Folate (ug/d)	400	1000	400
Biotin (ug/d)	30	ND	30
Vitmain B12 (ug/d)	2.4	ND	2.4
Vitamin C (mg/d)	90	2000	75
Vitamin E (mg/d)	15	1000	15
Vitamin A (ug/d)	900	3000	700
Vitamin d (ug/d)	5	50	5
Vitamin K (ug/d)	120	ND	90
Calcium (mg/d)	1000	2500	1000
Chromium (ug/d)	35	ND	25
Iron (mg/d)	8	45	18
Magnesium (mg/d)	400	350	310
Zinc (mg/d)	11	40	8
Phosphorus (mg/d)	700	4000	700
Selenium (ug/d)	55	400	5

Source: Information extracted from reference 23

Recommended Daily Allowances (RDA)

The micronutrients are vital for life and therefore essential components of our diet. The body cannot make any of the micronutrients (except vitamin D from the sun) so we need to intake an adequate amount from food, or supplement these if required.

There is no research to support that increasing daily dosages above the RDA levels significantly improves health or athletic ability, so supplementation is not essential.

There is evidence to suggest that vitamin C and E may enhance recovery after exercise by reducing oxidative stress and acting as strong antioxidants. Also, it has been highlighted that those with low iron levels, particularly menstruating females, would benefit from an iron supplement.

Ideally, by eating a well-balanced and complete diet, we should receive all the micronutrients in sufficient amounts, but this is not always the case with our clients.

Those with ‘poor’ diets i.e. lacking in any fruit and vegetables may suffer from deficiencies. Also, those who are following a low calorie intake for significant time periods may not be receiving sufficient micronutrients in their diet. In these cases supplementation can be warranted to ensure no deficiencies are present.

Overall, supplementation of micronutrients can be important for those who are not meeting there commended daily intakes for each.

THE NUTRITION FUNDAMENTALS

PHYTONUTRIENTS

The phytonutrients are a class of substances that are found in plant foods, are not essential nutrients yet appear to help promote health and reduce risk of many chronic conditions and diseases.

Phytonutrients, also known as phytochemicals, are responsible for providing plants with their colors such as red tomatoes and the distinctive aromas such as garlic. They naturally occur in plants and protect them from environmental factors such as sunlight and plant-eating insects.

For humans, we too can benefit from the phytochemicals that can be found in our foods such as fruits, vegetables, legumes, whole grains, herbs and seeds.

As they do not provide energy or building blocks for the body, they are not classified as essential nutrients, however they can still play a key role in the body by serving as powerful antioxidants that can help reduce blood pressure and cholesterol, prevent cataracts, reduce menopause symptoms and osteoporosis.

To date, there are thousands of known phytochemicals, yet most foods only contain a small number of these and even fewer in higher doses.

A Sampling Of Phytochemicals

Below you will find a sample of the key phytochemical classifications, food sources and possible health benefits.

BETA GLUCAN

Food sources: Oat bran, rolled oats, oat flour.

Possible health benefits: May play a role in cardiovascular health

CAPSAICIN

Food sources: Hot peppers.

Possible health benefits: May reduce risk of fatal clotting in heart disease.

CAROTENOIDS

- **Beta-carotene**

Food sources: Orange fruits and vegetables, dark green vegetables.

Possible health benefits: May help reduce risk of many diseases and support immune function

- **Lutein & zeaxanthin**

Food sources: Pumpkin, summer squash, corn, eggs, broccoli, dark green leafy vegetables.

Possible health benefits: May reduce risk of age-related eye disorders by protecting the retina from harmful UV radiation and neutralizing free radicals.

- **Lycopene**

Food sources: Tomatoes, watermelon, red grapefruit and peppers.

CURCUMIN

Food sources: Turmeric, a spice.

Possible health benefits: May inhibit enzymes that activate carcinogens. Flavonoids and other phenols e.g. Anthocyanin, ellagic acid, resveratrol

Food sources: Fruits, whole grains, nuts, chocolate, black or green tea, potato, red cabbage, beets, peppers, onions, soy, red wine.

Possible health benefits: May act as antioxidants, decrease inflammation, reduce plaque build up in arteries, increase HDL cholesterol levels, deactivate carcinogens and inhibit cancer development.

INDOLES

Food sources: Cruciferous vegetables.

Possible health benefits: May stimulate enzymes that make the hormone estrogen less effective, possibly reducing breast cancer risk.

ISOTHIOCYANATES

Food sources: Broccoli, kale and other cruciferous vegetables.

Possible health benefits: May help stimulate protective enzymes that detoxify carcinogens, bolstering the body's natural ability to ward off cancer.

MONOTERPENES

Food sources: Citrus (fruits, juices, peels, oils).

Possible health benefits: May act as antioxidant and increase production of enzymes that may help the body dispose of carcinogens.

ORGANOSULFUR COMPOUNDS

Food sources: Onions, garlic, chives, leeks.

Possible health benefits: May block the action of cancer-causing chemicals, may offer heart protection by decreasing production of cholesterol by the liver.

PHYTIC ACID

Food sources: Whole grains.

Possible health benefits: May prevent free radical formation by binding to minerals and thereby reduce cancer risk.

PHYTOESTROGENS

- **Isoflavones**

Food sources: Soy foods and other legumes.

Possible health benefits: May protect against heart disease by lowering blood cholesterol, may lower risk of breast, ovarian, and other cancers by blocking the action of the hormone estrogen.

- **Lignans**

Food sources: Flaxseed, whole grains.

Possible health benefits: Exhibits estrogen-blocking activity and may lower risk of breast, ovarian, colon and prostate cancer.

SAPONINS

Food sources: Sprouts, potatoes, green vegetables, tomatoes, nuts, whole grains, soy foods, legumes.

Possible health benefits: May strengthen the immune system and interfere with DNA replication, preventing cancer cells from multiplying.

Tannins

Food sources: Grapes, red and white wine, tea.

Possible health benefits: Act as antioxidants, may inhibit enzymes that activate carcinogens.

Mechanisms Of Actions Of Phytochemicals

There are various mechanisms through which phytochemicals will act:

1. Antioxidant properties (protecting against harmful cell damage)
2. Anti estrogen properties
3. Anti cancer properties (preventing initiation and promotion of cancer)

These actions are then carried out by direct and indirect mechanisms:

1. Directly – they may directly act to inhibit enzymes that activate carcinogens or to induce enzymes that detoxify carcinogens.
2. Indirectly – they may indirectly act by stimulating the immune response or scavenging free radicals.

Optimising Phytochemicals In An Eating Plan

A well balanced diet based of whole foods coming from ample amounts of fruit, vegetables, legumes, whole grains, herbs and seeds should provide the body with sufficient phytochemicals.

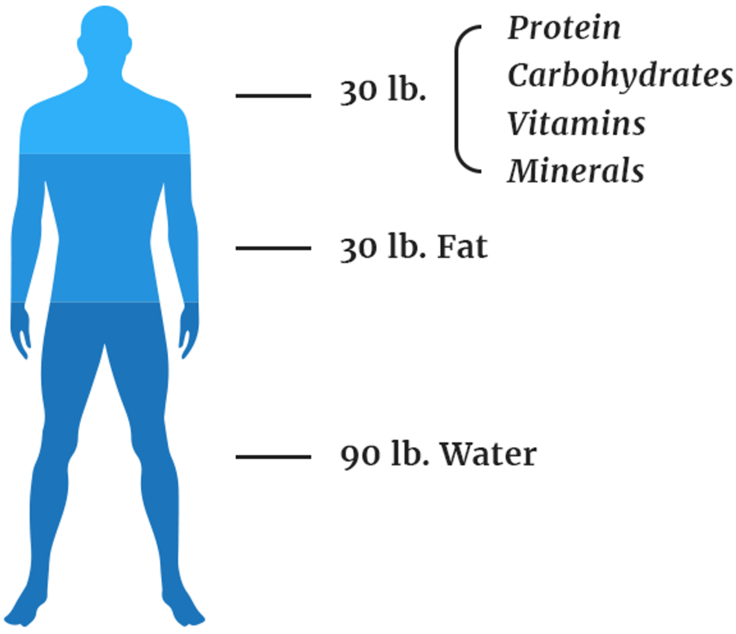
The whole food approach is likely to be more effective than supplementation, as we know the absorption, metabolism and distribution of some nutrients are dependent upon the presence of other nutrients. The same applies to phytochemicals, as taking individual amounts may not provide the same functions or protection as a combination from various sources.

THE NUTRITION FUNDAMENTALS

WATER

For the human body, water is a vital resource. We know it is indispensable for life itself, and it provides a host of essential functions for good health.

There is no more important nutrient in our bodies than water. It is the most widely used nutrient at work within the body's functions and processes, as well as constituting a huge part of its physical makeup.



The typical man is made up of around 60% water, a woman around 50% and our brains around 75%. We can only survive a small number of days without water, yet can survive weeks without food.

Daily water intake is extremely important in helping to replenish that lost through our bodily processes including urination, sweating and breathing.

When the water is not replaced, we become dehydrated:

1 % dehydration - we become thirsty with reduced concentration (1)
5% dehydration - we become hot and tired with decreased performance (2) (3) (4)
10% dehydration - delirium and blurred vision (5) (6) (7)
20% dehydration - may result in death.

Water is a chemical compound with the chemical formula H_2O. A water molecule contains one oxygen and two hydrogen atoms that are connected by covalent bonds.

The Functions Of Water In The Body

- **Transports nutrients through the body**

Once a substance is dissolved in water, water becomes vital for transporting it throughout the body. Blood - which is 83% water - transports oxygen, CO_2, nutrients, waste products and more from cell to cell. Urine is also mostly water. Another very important transporter, urine removes waste products from the body.

- **Moistens eyes, mouth and nose**

Water is needed for protection as well. It keeps your mouth moist and washes away dirt and grime on your eyes. Water even lubricates our joints, keeping them from getting stiff and making sure motion is smooth.

- **Can help maintain pH and electrolyte balance**

Our bodies must maintain a very specific pH level of 7.4. pH values of less than 6.9 or greater than 7.6 are life threatening so it is essential that we have ways to keep pH from deviating too far from normal. Water is a reactant within a very important reaction that maintains pH at 7.4. Water is essential to maintaining electrolyte balance within our bodies. Electrolytes are charged ions (such as Na^+ or Cl^-) which must be kept at certain levels to maintain the proper amount of water in our cells.

- **Participates in many chemical reactions**

As a chemical reactant, water is involved in many processes and pathways of the body. We use it to digest food in the gastrointestinal tract, to access stored energy for muscles and organs, and for countless other reactions.

- **Helps regulate normal body temperature**

Serves as a shock absorber inside the spinal cord and in the amniotic sac surrounding the fetus.

- **Reduces chances of kidney stones**

Increased water intake appears to decrease the risk of kidney stones. (8) (9)

- **May reduce cancer risk**

There are some studies showing that those who drink more water have a lower risk of bladder and colorectal cancer, although other studies found no effect. (10) (11) (12)

- **May reduce constipation**

Increasing water intake can help with constipation. (13) (14)

- **Ensures adequate blood volume**

- **Forms main components of body fluids**

Properties Of Water

- **Boiling point 100 degrees Celsius**
- **Freezing point 0 degrees Celsius**
- **PH=7**
- **Polarity = polar**
- **Conducts electricity = Not in pure H2O form**
- **Density at 25 degrees Celsius: 1g/cm3**

Water As A Solvent

Water is the fundamental solvent for all the biochemical processes within the body. A solvent is the dissolving medium to which a solute (the substance to be dissolved) like a solid, liquid or gas is added. Water is a very important solvent that many different molecules in our bodies dissolve in.

When a solvent dissolves a solute, it is known as solvation. Solutes that solvate in water into ions in the body are known as electrolytes. These play important roles in our bodies from nerve transmission to muscle contraction.

Molecules that can be solvated by water molecules are called hydrophilic. Molecules that do not dissolve in water are called hydrophobic.

Electrolytes are single, electrically charged particles and play an important role in maintaining water balance and acid base balance in the body.

Sodium, potassium, prosperous and chloride are examples of electrolytes – dissolved substances in blood and body fluids that carry electric charges.

The key role of electrolytes is to balance the fluids inside and outside of the cells, so they can function properly and allow body fluids to bring cells the necessary nutrients while removing waste products.

Electrolytes also help create the environment in which the cells work takes place e.g. nerve-nerve communication, heartbeats and contraction of muscles.

There is another key reason why remaining hydrated is so important. When we lose fluid from the body, we also lose electrolytes. Maintaining healthy concentrations of electrolytes is critical in supporting the important activities of the vital organs.

Types of Water

Water enters the body via liquid and foods, and some water is created within the body itself as a by-product of metabolic processes.

There are two types of water that we typically consume. This is usually determined by its source and how it is processed. It is also based on its concentration levels of three minerals - calcium, magnesium and sodium.

- **Hard water**

Is usually sourced from low level sources and is known to contain high levels of minerals, primarily calcium and magnesium.

- **Soft water**

Is usually sourced from high level sources or from deep in the earth, and has a higher level of sodium.

Sources Of Water

- **Potable (drinking) water**

Drinking water is safe enough to be consumed by humans or used with a low risk of immediate or long-term harm.

The majority of our drinking water in the UK is consumed from the tap, but this is also used for toilet flushing, washing and landscape gardening etc.

All of our drinking water has been 'treated' before use and the extent of this depends on the source of the water.

- **Bottled water**

Bottled water is big business and many people are buying this because of perceived health and safety benefits, or for its improved purity and 'taste free' factors.

This may not be the case, as there are no existing guidelines in place to require bottled water to meet higher standards for quality, such as a maximum level of contaminants, than for public drinking water supplies.

It is suggested that anywhere between 25-40% of bottled water comes from the same municipal supplies as tap water, and has only been filtered to remove chlorine to improve taste.

It's therefore important to understand the various sources of bottled water and how this may affect its overall quality.

- **Artesian water**

Water drawn from a well that taps into a confined water-bearing rock.

- **Ground water**

Water which comes from an underground source of water that does not come into any contact with surface water.

- **Mineral water**

Water that is drawn from an underground source and contains at least 250 parts per million of dissolved solids.

Low mineral content = 250-500 parts per million of total dissolved solids.

High mineral content = 1500+ parts per million of total dissolved solids.

- **Purified water**

Water from which all minerals have been removed. Also known as distilled water.

- **Sparkling bottled water**

Water in which carbon dioxide is naturally present.

- **Spring water**

Water derived from an underground formation from which water flows naturally to the surface of the earth.

- **Well water**

Ground water derived from a rock formation.

Water Intake

Water leaves the body through several routes - the evaporation of sweat, in the moisture of exhaled breath, in the urine and in the faeces. It is also used to facilitate all the previously mentioned functions in the body.

This amounts equals between 1.4-2.8 liters per day.
Adults are advised to consume 1-1.5 ml of water for each calorie-expended daily.

For example: if your daily energy expenditure (BMR x activity level) is 2000kcal per day, then you would require 2-3 liters of water per day.

Water consumption throughout training should be a given, and it is suggested for every pound in body weight lost between the start and finish of training, 500ml of water per pound should be replaced.

When recommending daily water intake to clients, the general guidelines work very well:

- **When thirsty, drink.**
- **When not thirsty anymore, stop.**
- **During high heat and exercise, drink enough to compensate for the lost fluids.**

THE NUTRITION FUNDAMENTALS

FRUCTOSE: THE GOOD, THE BAD, THE UGLY

The great debate continues – is fructose good or bad for us?

Over the last few years we have seen a lot of media coverage and publications on this very question. Some say that fructose is the sole root cause of our obesity problems, while others say it is no worse than any other nutrient.

Let's break down what fructose actually is, the issues it may cause and what the current research and reviews suggest.

What Is Fructose?

Fructose is a type of sugar and is also known as a fruit sugar formed from simple carbohydrates known as monosaccharides. In terms of its chemical structure it is exactly the same as glucose, another popular sugar, however fructose is the sweetest tasting of all sugars.

Many people associate fructose with fruit, yet it is largely consumed in today's society via a number of processed foods that we now eat, added as high-fructose corn syrup.

Aside from the sweetness aspect of this sugar, its popularity mainly came about for economic reasons. Fructose has only recently been an addition to our foods (aside from natural products), so here's a short history lesson.

1957: Two scientists called Richard Marshall and Earl Kooi discovered 'Aeromonas hydrophilia', a bacterium that turns corn kernels into fructose. At this time cane sugar was heavily used for sweetening products.

1970's: It wasn't until a large spike in cane sugar prices occurred in the 70's when manufacturers decided to look for alternatives to cane sugar. This is when they discovered that corn prices were dirt-cheap and the process created by Marshall & Kooi could turn it into fructose.

Since then food manufacturers haven't looked back, and we are now surrounded by foods containing fructose from high fructose corn syrup (HFCS) and sucrose (table sugar), which is a disaccharide made up of glucose and fructose.

2000's: It wasn't until the early 2000's when two nutrition scientists called Barry Popkin and George Bray published a scientific nutrition paper in the American Journal of Clinical Nutrition that highlighted a link between the increasing use of HFCS (fructose) and the rising American obesity problem. (1)

The Issues With Fructose

This research, along with others began to highlight some negative health aspects from consuming this relatively new substance.

Here's a quick breakdown of the common issues raised:

OBESITY

Fructose is metabolized by the liver, thus bypassing the muscle cells, our main storage compartment for glucose. Our livers can only hold so much glucose before it is saturated and passes the surplus fructose onto storage (as it is not needed), into our fat cells.

Therefore, if we eat more than we burn off, it will then be stored in fat cells for later use. (2) (3) This rule however, applies to all sugars and not just fructose, but it is still important.

INSULIN RESISTANCE

As already mentioned, as fructose is metabolized in the liver, it does not cause the pancreas to release insulin the way it normally would in relation to carbohydrate consumption.

Insulin is the key hormone responsible for shuttling carbohydrates to the body's cells. As fructose does not trigger a significant response to sugar, it can remain in the blood. This creates a condition called hyperinsulinemia, meaning too much insulin in the blood stream.

The result can be an insulin-resistant liver which means its production of glucose becomes dysregulated, thus it does not effectively reduce glucose output even though there is a plentiful supply of blood sugar available.

This forces the body to release even more insulin (even without the presence of consumed carbohydrates) as the liver continues to produce glucose, causing us to also become insulin resistant at the pancreas.

This commonly leads to periods of hypoglycemia, which is a key feature of the metabolic syndrome, a cluster of symptoms believed to cause type II diabetes, obesity and heart disease. (4)

TRIGLYCERIDE RISE

The research also showed that high fructose intake paired with excess energy intake can raise serum triglyceride (TC) levels due to an over production in the liver. Elevated TC's have been linked to cardio vascular diseases. (5)

LEPTIN & GHERLIN LINKS

Leptin is a hormone responsible for signaling to the body that we have had enough food – we are full. Ghrelin is another hormone that acts as the opposite to leptin – it signals when we are hungry. It has been shown that fructose does not cause any responses to these hormones, meaning it is very easy to overeat. (6)

There is also research to suggest that fructose may increase blood pressure, reduce HDL (good cholesterol levels) and increase fatty acid deposits in the liver. (7)

Does The Evidence Hold Up?

It appears fructose can cause us a few problems, but were we too quick to point the finger and solely blame this sugar for all of our problems? Perhaps so.

There are a couple of glaring issues with some of the existing data and research:

CORRELATION DOES NOT MEAN CAUSATION

Data trends from the 1970's shows not only an increase in fructose consumption but also in overall daily caloric intake – from flour products and fats (oils and dairy). It is therefore difficult to pin point one food as the main problem, which we appear to be doing in this instance.

Furthermore, since 2000 fructose consumption has decreased (possibly due to the research on and the popularity of low carb diets) yet we still see an average daily 500 caloric increase since the 70's. This shows that fructose may not be the key player in making us eat more.

ANIMAL RESEARCH

Much of the research was conducted on animals, not humans. There appears to be a significant difference between how a rat and a human responds to fructose, mainly due to the fact that fructose does not behave any differently in humans than any other carb source.

FRUCTOSE IS NOT EATEN ON ITS OWN

Many of the main health issues associated with fructose are based on the consumption of this sugar alone, with no other foods present. This clearly isn't the case in our day to day eating habits.

We don't eat fructose; we eat food that contains fructose!

The Benefits And How Much Should We Take?

If you are eating whole unprocessed foods that naturally contain fructose then you shouldn't be worried about any health issues with fructose.

Fructose can be found in many fruits (and veggies), which not only taste good but also contains a host of vitamins, minerals, antioxidants, fibre and polyphenols.

Therefore, eliminating some of these foods because they contain some fructose would not be wise– the benefits far outweigh the negatives.

The body does just fine at handling modest amounts of fructose too, and the typical guideline is around 15-25 grams per day. (8)

Many common fruits do not surpass single figure amounts of fructose, meaning a number of pieces of fruit per day can be consumed within those guidelines.

Avoiding a diet high in processed and refined carbohydrates will ensure you stay well within the recommended guidelines, and it all comes down to one thing – balance.

THE NUTRITION FUNDAMENTALS – PART II
WORKBOOK

Q1. WHAT ARE MICRONUTRIENTS AND HOW ARE THEY MEASURED?

Insert text here

Q2. WHAT ARE THE TWO CLASSIFICATIONS OF VITAMINS?

Insert text here

Q3. THE MICRONUTRIENTS ARE PRESENT IN WHICH TWO FOOD GROUPS THE MOST?

Insert text here

Q4. WHAT ARE PHYTONUTRIENTS?

Insert text here

Q5. WHAT BENEFITS CAN PHYTONUTRIENTS BRING?

Insert text here

Q6. WHAT IS CONSIDERED THE MOST IMPORTANT NUTRIENT TO THE BODY?

Insert text here

Q7. DESCRIBE WHAT HAPPENS WHEN THE BODY BECOMES DEHYDRATED?

Insert text here

Q8. WHAT ARE THE KEY FUNCTIONS/ROLES OF WATER IN THE BODY?

Insert text here

Q9. WHAT ARE ELECTROLYTES?

Insert text here

Q10. WHAT IS THE KEY ROLE OF ELECTROLYTES?

Insert text here

Q11. WHAT TYPES OF WATER ARE THERE?

Insert text here

Q12. WHAT 3 MINERALS ARE TYPICALLY FOUND IN WATER?

Insert text here

Q13. ADULTS ARE ADVISED TO CONSUME HOW MUCH WATER PER DAY FOR EACH CALORIE EXPENDED?

Insert text here

Q14. WHAT IS FRUCTOSE?

Insert text here

Q15. WHAT IS THE RECOMMENDED DAILY INTAKE FOR FRUCTOSE?

Insert text here

REFERENCES & FURTHER READING

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