

NUTRIENTS: FUNCTIONS, SOURCES & REQUIREMENTS

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- This Factsheet is about the nutrients in food. Eating a healthy balanced diet, including all of the food groups, as outlined in Factsheets 1.1 and 1.2, will provide all the nutrients and energy toddlers need (apart from vitamin D in some cases - see Factsheet 1.1).
- Most toddlers have body stores of all these nutrients and poor eating for a day or two will not deplete them of any. Over a week or so toddlers' nutritional intakes will usually average out and cover their full needs.
- This Factsheet is not a guide to what toddlers should eat - that is covered in Factsheets 1.1 and 1.2 - but summarises in what foods nutrients can be found, what they do, how much of them is needed and the signs of nutrient deficiencies or excess. The nutrient requirements of toddlers are expressed as a reference nutrient intake (RNI), a term that is explained on page 2.

DIETARY REFERENCE VALUES FOR NUTRIENTS

The terms below appear on the labels on foods and drinks, and on vitamin and mineral supplements. They are also used by public health bodies, government and other agencies, to define nutritional requirements. Collectively they are called 'dietary reference values' (DRV).

RNI 'Reference Nutrient Intake' is the amount recommended per day for any age group to make sure they all get enough.

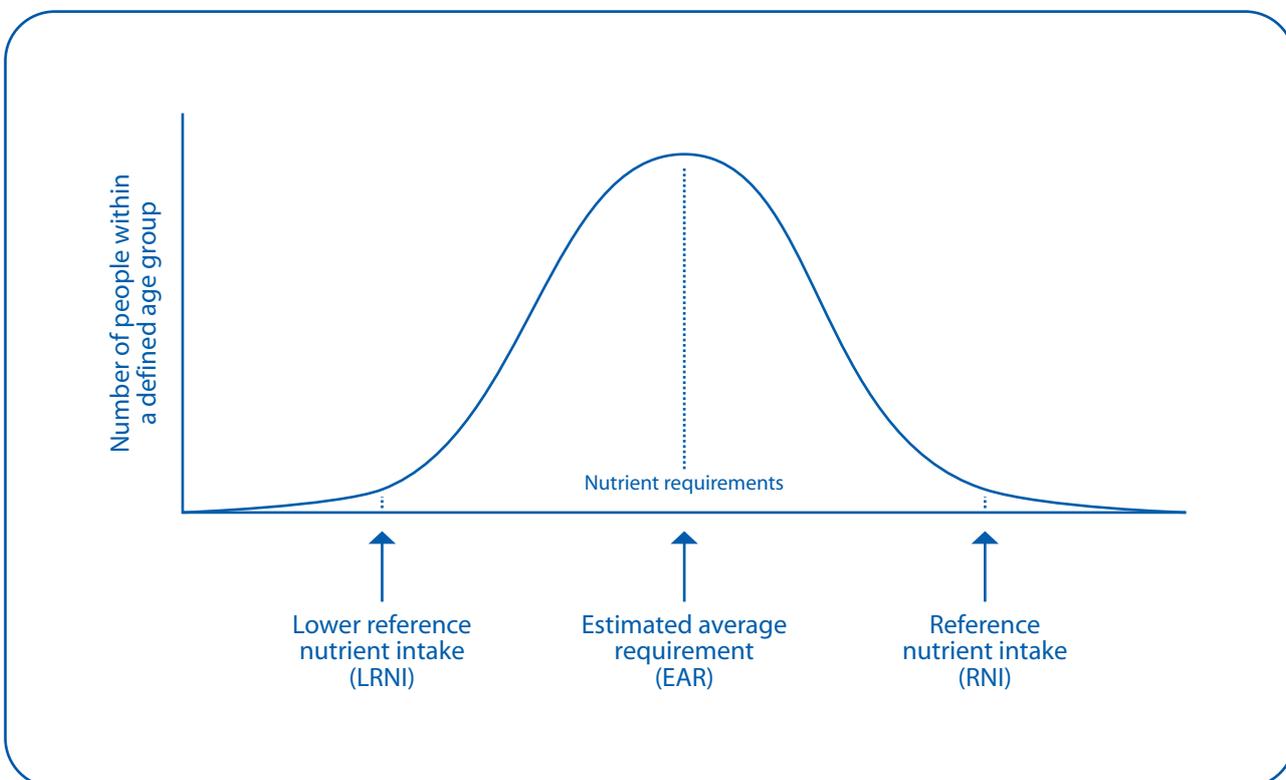
EAR 'Estimated Average Requirement' is the average needed for a defined age group.

LRNI 'Lower Reference Nutrient Intake' is the amount below which most people in a defined age group will be deficient.

RDA 'Recommended Daily Amount' is used for the whole population but **should not be used for toddlers and young children as it applies to adults.**

The relationship between these terms is shown in the bell-shaped curve below, which describes the normal range of nutrient requirements of a population of a defined age group. DRVs vary according to the age of people and sometimes to their body weights. In toddlers estimates of some RNIs are based on limited data. DRVs change over the years and should be regarded as best estimates at the time that they were set. They are often reviewed in the light of new information.

RNIs have been set 'high' on the curve in order to ensure that they supply the needs of the vast majority. With the exception of energy (excess energy intake leads to obesity) consumption of a nutrient above its RNI is not harmful, unless in great excess.



| Nutrient | Function in the body ¹ | Food sources which toddlers enjoy ^{2,4} | Daily requirement (RNI) for 1-3 year olds ³ | Signs of deficiency or excess in toddlers ^{4,5} |
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| <p>Protein Made up of, and is a source of, peptides and amino-acids.</p> | <p>Provides structure for all cells in the body, enzymes and carrier molecules.</p> <p>Growth increases requirement as extra protein is needed for new muscles and other cells.</p> | <p>Richest sources are milk, yogurt, cheese, meat, fish, eggs, ground and chopped nuts and peanut butter - see back page for caution with peanuts and whole nuts*.</p> <p>Good sources are pulses such as dhal, lentils, baked beans, hummus and other starchy beans: chick peas, butter beans and red kidney beans.</p> <p>Cereals and foods containing flour such as bread, chapatti and pasta also provide some protein.</p> | <p>14.5g/day.</p> | <p>Deficiency of protein alone is rarely seen in the UK. Poor growth and development would result.</p> <p>Muscle wasting is a sign of severe protein deficiency although it can have other causes.</p> |
| <p>Carbohydrate May be 'simple' sugars, such as sucrose and glucose, or 'complex' such as starches and some fibre.</p> <p>Fructose is the sugar in fruit and honey.</p> <p>Lactose is the sugar in milk.</p> | <p>Provides energy (calories).</p> | <p>Potatoes, yam, breakfast cereals, couscous, rice and any foods containing flour such as bread, chapatti, pasta, pastry, biscuits and cake.</p> <p>Fruit, honey and milk.</p> <p>Milk puddings such as sago, and tapioca as well as rice.</p> <p>Foods containing refined sugar such as sweet drinks and foods e.g. puddings and sweets.</p> | <p>No RNI.</p> <p>Requirements depend on activity and how much fat is eaten.</p> | <p>Insufficient energy (calories) from carbohydrate (and fat) causes poor growth and development. Faltering growth due to low calorie intake is not uncommon in the UK.</p> <p>Excess carbohydrate intake can cause obesity.</p> <p>Excess and frequent intake of simple sugars can cause dental caries. In the UK about 10% of toddlers have dental decay.⁶</p> |
| <p>Fat Sometimes called 'lipid', and is made up of -</p> <ol style="list-style-type: none"> Fatty acids which may be short, medium or long chains of: <ul style="list-style-type: none"> • saturated • mono unsaturated • polyunsaturated including omega 3 & omega 6 Complex fats e.g. cholesterol and phospholipids. | <p>Provides energy.</p> <p>The membranes of all cells are made of lipids, including those of the nervous system.</p> <p>The omega 3 and 6 fats are essential for brain and nerve function and healthy skin.</p> <p>Transport of fat soluble vitamins.</p> | <p>Oils and fats used to fry foods.</p> <p>Butter, margarine and other spreads for bread.</p> <p>Cream and cheese.</p> <p>Cakes, biscuits and crisps.</p> <p>Small amounts in whole milk and yogurt, egg yolks and lean meat.</p> <p>There are usually plenty of omega 6 fats in the diet.</p> <p>Oily fish in fish pie or fish cakes are good sources of omega 3 long chain fats, DHA (docosahexaenoic acid) and EPA (eicosapentaenoic acid).</p> | <p>No RNI.</p> <p>About 35-40% of energy should be taken as fat.</p> <p>Omega 3 and omega 6 fats are essential - the body cannot make them, and they must be part of the diet.</p> <p>0.2% or more of total energy should come from omega 3 fats.</p> <p>1% or more of total dietary energy should come from omega 6 fats.</p> | <p>Insufficient energy (calories) from fat (and carbohydrate) causes poor growth and development.</p> <p>Excess fat intake can cause obesity.</p> |

| Nutrient | Function in the body ¹ | Food sources which toddlers enjoy ^{2,4} | Daily requirement (RNI) for 1-3 year olds | Signs of deficiency or excess in toddlers ^{4,5} |
|---|--|--|--|---|
| Fat (continued) | | <p>Rapeseed oil and walnut oil are good sources of omega 3 ALA (alpha-linolenic acid). Most pure vegetable oil in the UK is from rapeseed.</p> <p>Olive and soya oils have a good balance of omega 3 and omega 6.</p> | | |
| <p>Fibre</p> <p>Also called 'non-starch polysaccharides'.</p> <p>Fibre includes:</p> <ul style="list-style-type: none"> • non-digestible carbohydrates, mostly derived from plant material, that are fermented in the colon • prebiotics | <p>Regular functioning of intestines and bowel.</p> <p>Feeds the bacteria in the colon and maintains colonic health.</p> | <p>Fruits and vegetables, cereals and foods made from flours.</p> <p>Wholegrain cereals such as porridge, Ready Brek and Weetabix contain more fibre than most processed cereals.</p> <p>Wholegrain flours and breads will contain more fibre than white flour and breads.</p> | <p>There are no definite recommendations for toddlers in the UK, but about 5-7g is an average intake.</p> | <p>Constipation and disordered bowel habit may occur with too little fibre intake.</p> |
| Fluid | <p>For maintaining normal hydration, blood pressure and fluid balance.</p> <p>Toddlers' bodies are about 70% water.</p> | <p>Milk, fruit juices and diluted squashes are all about 90% water.</p> <p>Soups, sauces and fruit and vegetables have high water contents.</p> | <p>Six to eight drinks per day in addition to fluid in some foods.</p> <p>About 120mls (4oz) is an average drink for one to three year olds.</p> <p>More may be needed on a very hot day and after a lot of physical activity.</p> | <p>Constipation can be a result of too little fluid intake. This is fairly common in the UK.</p> <p>Dehydration caused by not enough fluid, can cause lethargy.</p> |

Vitamins

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| <p>Vitamin A (Retinol and β-Carotene)</p> | <p>Ensures normal growth and development, strengthens immune system, healthy skin and good night vision.</p> | <p>Whole cows' milk.</p> <p>Orange, red and dark green fruit and vegetables such as carrots, red peppers, tomatoes, sweet potato, pumpkin, apricots, mangoes, cantaloupe melons, broccoli.</p> <p>Fish pie or fish cakes using oily fish.</p> <p>Liver pâté.</p> | <p>400ug/day.</p> | <p>Deficiency causes night blindness, skin problems, and increased infections, particularly of the respiratory and gastrointestinal tracts.</p> <p>40% of toddlers in the UK have insufficient vitamin A in their diets⁴.</p> |
| <p>B vitamins</p> <p>Include thiamin, folic acid, niacin (nicotinamide), riboflavin, pyridoxine, biotin, pantothenic acid and cyanocobalamin.</p> | <p>Growth and development of healthy nervous system.</p> <p>Involved in converting food into energy.</p> | <p>Liver pâté and yeast extracts such as Marmite are the only foods that contain all the B vitamins.</p> <p>Most breakfast cereals are fortified with extra B vitamins.</p> | <p>0.5mg/day vitamin B₁ (thiamin).</p> <p>0.6mg/day vitamin B₂ (riboflavin).</p> <p>8mg/day vitamin B₃ (niacin).</p> | <p>Deficiency causes cracked and sore skin in some cases, and anaemia and heart failure.</p> |

| Nutrient | Function in the body ¹ | Food sources which toddlers enjoy ^{2,4} | Daily requirement (RNI) for 1-3 year olds | Signs of deficiency or excess in toddlers ^{4,5} |
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| B vitamins (continued) | | Other good sources are meat, milk, yogurt, cheese, fish, eggs, seeds, bread and vegetables. | 0.7mg/day vitamin B ₆ (pyridoxine). 0.5ug/day vitamin B ₁₂ (cyanocobalamin). 70ug/day folate. Pantothenic acid - no recommendation. Biotin - no recommendation. | Damage to nerves may result from anaemia due to insufficient vitamin B ₁₂ or folate. Spina bifida can be caused by insufficient folate in early months of pregnancy. B vitamin deficiencies are rarely seen in toddlers in the UK. |
| Vitamin C (ascorbic acid) | Helps absorption of iron from non-meat sources. Antioxidant that protects cells from damage. Maintains blood vessels, cartilage, muscle and bone. Strengthens immune function and aids wound healing. | Most fruit and vegetables contain some. The richest sources are blackcurrants, kiwi fruit, citrus fruits, tomatoes, peppers and strawberries. Potato, sweet potatoes and mangoes are also good sources. Some fruit juices and squashes often have added vitamin C. | 30mg/day. | Deficiency causes slow wound healing, recurrent infections and bleeding gums. In extremely rare cases vitamin C deficiency can cause scurvy. One in three toddlers in the UK does not have enough vitamin C in the diet ⁴ . |
| Vitamin D | Needed to absorb calcium into the body, and to regulate its movement in and out of the skeleton ensuring strong bones. | Most vitamin D is made in the skin when toddlers are outside during the summer months i.e. April - September in the UK. It is the ultraviolet sunlight which acts on exposed skin to make vitamin D. Fish cakes or pie made with oily fish, margarine and whole milk. Some breakfast cereals have vitamin D added. Follow-on milks and toddler milks are enriched with it. | 7ug/day. | Deficiency can cause weakness of the muscles and twitching (tetany), rickets and bone deformities. This is not unusual in the UK especially toddlers of Asian, African and middle-eastern ethnic origins. |
| Vitamin E | Antioxidant that protects cell structures. | In a wide variety of foods. Rich sources are vegetable oils and margarine, avocados, almonds, meat, fish, eggs. | No RNI. | Deficiency very rarely seen in toddlers. |

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| Vitamin K | Blood clotting. | Mainly produced by bacteria in the large bowel. Rich food sources are green leafy vegetables and broccoli. | No recommendation. | Tendency to bleed can sometimes be due to deficiency. |
| Minerals | | | | |
| Calcium | Bone strength and teeth. Cell structure and function. | Richest sources are milk, cheese, yogurt and fortified soya milk. White bread is fortified with calcium. Biscuits or cakes with ground almonds. Canned fish with bones such as sardines. | 350mg/day. | Deficiency can cause fits or bone deformity due to rickets. |
| Copper | Energy and protein production. | In small amounts in most foods. | 0.4mg/day. | Deficiency is very rare in the UK. Fragile bones and increased infections can be effects of deficiency. |
| Fluoride | Strengthens tooth enamel and helps to prevent tooth decay. | Pea sized amount of fluoride toothpaste on toothbrush when cleaning teeth twice a day provides enough. Supplied by drinking water in areas where tap water is fluoridated or the water naturally contains adequate levels. Water is not fluoridated in Scotland, Northern Ireland and some areas of England. For information on fluoridated water in England and Wales see: | Safe intake is 0.12mg/Kg body weight/day. | Dental caries are more common with fluoride deficiency. In the UK about 10% of toddlers have dental decay ⁴ . Dental fluorosis or brown spots on teeth is caused by excess intake of fluoride. This is usually due to giving too much of a fluoride supplement. |
| Iodine | Part of the hormone thyroxine, which helps convert food into energy and assists general mental and physical development. | | 70ug/day. | An enlarged thyroid gland may indicate deficiency. |

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| Iron | <p>Necessary for carrying oxygen around the body in the blood (haemoglobin) and muscles (myoglobin).</p> <p>Also involved in energy metabolism and the immune system.</p> | <p>Best sources are red meat (beef, lamb and pork) and dark poultry meat e.g. chicken legs and thighs. White meat such as chicken breast has less.</p> <p>Other sources are:</p> <ul style="list-style-type: none"> • fortified breakfast cereals • ground or chopped nuts (see back page for caution with peanuts and whole nuts*) • dhal, lentils, hummus • poppadums made with lentil flour • bhajis and Bombay mix made with chickpea flour <p>Smaller amounts are in fruit and vegetables.</p> <p>Follow-on milks and toddler milks are fortified with it.</p> | 6.9mg/day. | <p>Iron deficiency causes anaemia, increases susceptibility to infections, lethargy, and delays physical and mental development.</p> <p>In the UK one in eight toddlers is anaemic*.</p> |
| Magnesium | Helps bone development, protein production and converting food into energy. | <p>Best sources are wholegrain breakfast cereals, milk and yogurt.</p> <p>Also in meat, egg, dhal, lentils, hummus, potatoes and some vegetables.</p> | 85mg/day. | <p>Deficiency can cause muscle weakness, poor growth and neuromuscular function.</p> <p>This is rare in the UK.</p> |
| Phosphorus | Bone growth and energy metabolism. | <p>Richest source is milk.</p> <p>Present in most other foods.</p> | 270mg/day. | <p>Deficiency is rare and only seen in association with other conditions which cause malabsorption.</p> |
| Potassium | Important for fluid balance, muscle contraction and nerve conduction. | <p>Milk, vegetables and potatoes.</p> <p>Bananas, dried apricots, prunes, dates and kiwi fruit are also good sources.</p> | 800mg/day. | <p>A deficiency which causes muscle weakness is rarely seen unless there are kidney problems.</p> |
| Selenium | Antioxidant. | Meat, fish, vegetables and cereals. | 15ug/day. | <p>Heart problems have been linked to selenium deficiency in China but it is rarely seen elsewhere.</p> |

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|---------------|--|--|---|--|
| Sodium | Important for acid-base regulation, fluid balance and blood pressure. | Salt is the main source so processed foods with added salt such as crisps, bacon, ham, cheese and bread contain the highest amounts. It is also found in meat, milk and yogurt. | 500mg/day. | Rare but can cause loss of appetite and mental confusion. Excess salt increases thirst and can cause fits and death. Chronic high sodium intake may cause hypertension. |
| Zinc | Involved in the function of many enzymes. It has a structural role in growth hormone and insulin. | Best sources are meat, fish and shellfish and eggs. Other good sources are milk, wholegrain breakfast cereals such as porridge, Shredded Wheat, Weetabix, and bread. Some in potatoes, dhal, lentils, hummus and leafy vegetables. | 5mg/day. | A deficiency causes wounds to heal slowly. A skin rash is seen in more severe cases of deficiency. Zinc deficiency is common in the UK. It is estimated that 70% of toddlers have insufficient zinc in their diets ⁴ . |

Phytochemicals

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| Substances in plants, which provide long-term protection against cancer and heart disease. Also called flavanoids, flavanols, isoflavones. Examples: lycopene lutein and quercetin. | Important antioxidants and play a part in immune function. | All fruit and vegetables, especially brightly coloured. Cocoa and chocolate. | No recommendation for individual phytochemicals but for adults, five servings of fruit and vegetables per day will ensure adequate intake. Giving toddlers fruit and/or vegetables at each meal will ensure they get enough. | Unknown in toddlers but adults who do not get enough are at higher risk of heart disease and cancer. |
|---|--|---|---|--|

* Toddlers with allergies (including eczema and asthma) which are thought to be due to food or other allergens, OR who also have immediate members of family (parents or siblings) with a food allergy or allergy (including eczema, asthma and hayfever) may be at higher risk of developing peanut allergy. Such children should be reviewed by their GP, health visitor or a medical allergy specialist before starting to eat peanuts or foods containing peanuts. Whole nuts should not be given due to the risk of choking.

References and Further Reading

1. Thomas B, Editor. *Manual of Dietetic Practice*. Third edition. London: *Blackwell Science*; 2001. 2. Food Standards Agency, McCance and Widdowson's *The Composition of Foods*. Sixth summary edition. *Cambridge: Royal Society of Chemistry*; 2002. 3. Department of Health. *Dietary Reference Values for Food Energy and Nutrients for the United Kingdom. Report on Health and Social Subjects 41: HMSO*; 1991. 4. Gregory et al. National Diet and Nutrition Survey: children aged 1 1/2 to 4 1/2 years. Vol 1: *Report of the diet and nutrition survey*. London: *HMSO*; 1995. 5. Michaelsen KF, Weaver LT, Branca F, Robertston A. Feeding and Nutrition of Infants and Young Children. *WHO Regional Publications, European Series* 87; 2000.

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