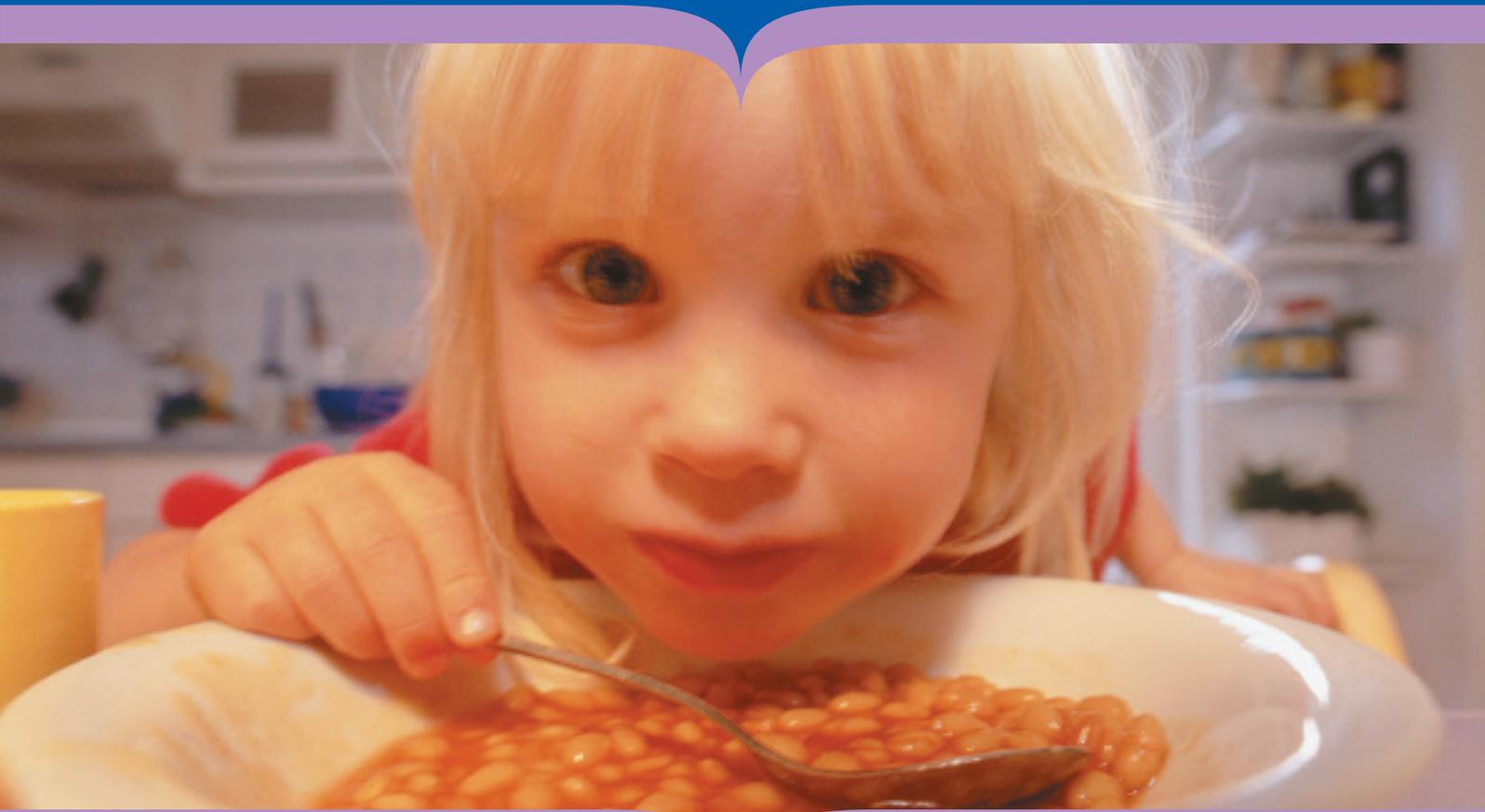


IRON DEFICIENCY ANAEMIA IN TODDLERS

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LEARNING POINTS

- 1** In the UK one in eight toddlers is anaemic. This figure may be as high as 25 to 35 per cent among ethnic minority and white young children from impoverished inner city areas of the UK.
- 2** Anaemia is defined as a blood concentration of haemoglobin of less than 110 g/l (11g/dl).
- 3** Iron deficiency is one of several causes of low haemoglobin, and causes iron deficiency anaemia (IDA).
- 4** Iron is essential for the function of many body systems including red blood cell production, muscle action, several enzymes, neurotransmitters, nerve development and the anti-bacterial properties of breast milk.
- 5** There are two types of dietary iron:
 - well-absorbed 'haem' iron from meat and oily fish
 - less well-absorbed 'non-haem' iron found in eggs, leafy green vegetables, grains, pulses and beans.
- 6** Iron absorption is inhibited by dietary fibre, calcium, phytates in flour and tannin in tea. Vitamin C in fruit and vegetables enhances intestinal iron absorption if consumed at the same time as iron-containing foods.
- 7** At birth infants have sufficient iron stores to last for up to six months. Preterm babies do not have these stores and so are vulnerable to iron deficiency.
- 8** Breast milk provides all nutritional needs, including iron, for about six months and then iron must be supplied by the weaning diet.
- 9** Even moderately low levels of haemoglobin, between 90-109g/l (9-10.9g/dl), can be associated with delays in cognitive and motor development and behavioural problems.
- 10** Over 50 per cent of toddlers aged 18 months to three years have iron intakes below the recommended intake. Toddlers with feeding problems are at particular risk of IDA.
- 11** Symptoms and signs of IDA include pallor, lethargy and tiredness and, with increasing severity, breathlessness and heart failure.
- 12** IDA is treated with an iron supplement (recommended dose: 3mg of iron/kg per day) and a healthy diet that includes foods rich in iron and nutrients that promote iron absorption.
- 13** Prevention of IDA includes nutritional education for parents and carers and ensuring adequate intake of iron rich foods.

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IRON DEFICIENCY ANAEMIA IN TODDLERS

Iron is one of the few micronutrients that can be deficient in the diets of vulnerable toddlers. [see Factsheet 4.1](#) In most cases this is due to insufficient awareness of healthy eating among parents and other carers, rather than to poverty or disease. Childcare professionals therefore play a key role in helping to educate parents of the importance of feeding their children a healthy, balanced diet [see Factsheets 1.1,1.2](#) that is not only sufficient in iron but also contains nutrients that aid its absorption.

WHAT IS IRON?

Iron is the second most abundant metal in the earth's crust. Yet iron deficiency is the world's most common form of malnutrition, believed to affect 43 per cent of children worldwide. Iron deficiency is due in part to biological systems that protect the body from iron's potentially toxic effects by limiting its absorption, as well as insufficient oral intake. Once absorbed from food, iron is distributed around the body, stored as ferritin and then transported to the bone marrow where it is incorporated into haemoglobin for red blood cell production. The child has no way of actively expelling excess iron.

WHY IS IRON AN ESSENTIAL NUTRIENT?

Iron is required for the formation of haemoglobin in red blood cells, which transport oxygen from the lungs to tissues. It is also found in myoglobin (red pigment of muscle), which stores oxygen for use during muscle contraction. Iron is an important part of many enzyme systems that liberate energy in cells. It is essential for the synthesis of neurotransmitters in the brain, the development of nerves and for the formation of lactoferrin which contributes to the anti-bacterial properties of breast milk.

TODDLERS' IRON REQUIREMENTS

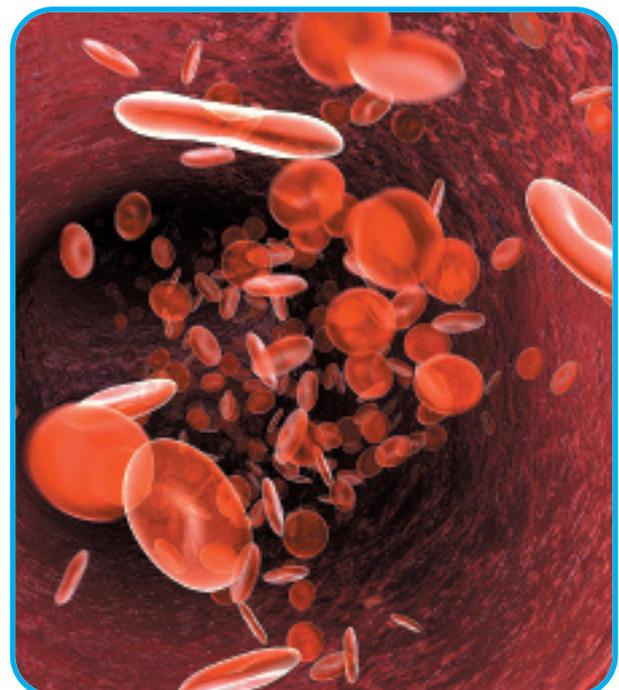
Provided that the mother's iron status during pregnancy has been adequate, the healthy newborn infant should have sufficient iron stores in the liver and other tissues to last for about six months. Preterm babies do not have these stores of iron and so are vulnerable to early iron deficiency. Breast milk will provide all infants' nutritional needs for about six months but after that the weaning diet must include sufficient iron rich foods to meet their high iron requirements.

These needs are defined by the Reference Nutrient Intake (RNI). [see Factsheet 1.1i](#)

Dietary Reference Nutrient Intake (RNI) of infants and toddlers for iron¹

Age	RNI mg/day
0-3 months	1.7
4-6 months	4.3
7-12 months	7.8
1-3 years	6.9

Infants need iron-rich foods during weaning so that they learn to like those foods before they may become wary of new foods at around 12 months. [see Factsheet 2.1](#) They will then be happy to eat them during their toddler years when they rely on foods rather than milks to supply their nutritional iron needs.



DIETARY SOURCES OF IRON

Iron in the diet is found in the well-absorbed 'haem' form in animal tissue such as red meat, meat products, offal, shellfish and oily fish. Less well absorbed 'non-haem' iron is found in pulses, nuts, eggs, leafy green vegetables, dried fruit, bread and oats. Examples of pulses are lentils, dhal, chickpeas, hummous and other starchy beans, and foods made from lentil or chickpea flours such as bhajis. Certain breakfast cereals are fortified with extra iron. Iron is added to white and brown flour to replace that lost in the milling process. Standard infant milk formulas, follow-on formulas and growing up milks are fortified with iron.



Dietary iron sources²

1 tablespoon = 15ml spoon

Food	Toddler's Serving Size		Haem iron content per serving (mg)
	Weight	Approximate equivalent	
Liver	25g	2-3 small thin slices	1.9
Lean beef	30g	½-1 slice	0.9
Lean lamb	30g	½-1 slice	0.7
Lean pork	30g	½-1 slice	0.3
Dark poultry meat	30g	1 small drumstick	0.3
Chicken breast	35g	1 small slice	0.1
			Non-haem iron content per serving (mg)
Fortified breakfast cereal	18g	4-5 heaped tablespoons	2.1
Cooked lentils/dhal	66g	3 tablespoons	1.6
Egg		1 small egg	1.0
Dried apricots	24g	3 apricots	1.0
Hummus	36g	2 tablespoons	0.7
White bread	36g	1 small slice	0.6
Porridge – made up	100g	6-7 tablespoons	0.5
Steamed/fried tofu	36g	3 tablespoons	0.4
Spinach – cooked	30g	1 tablespoon	0.3
Banana	60g	1 small banana	0.2
Cooked broccoli	20g	1 tablespoon	0.2
Mashed potato	40g	2 tablespoons	0.1

IRON ABSORPTION AND LOSSES

The amount of iron absorbed through the gut is small. The poor bioavailability of non-haem iron in cereals and vegetables limits its absorption to 5 to 15 per cent compared with 20 to 30 per cent of haem iron from blood and muscle in meat. Dietary fibre and chemical substances including calcium, phytates in wholemeal flour and unleavened bread and tannin in tea bind iron in the gut and reduce the amount that is absorbed into the body. On the other hand vitamin C in fruit and vegetables will enhance iron absorption if consumed with iron-rich foods.

Foods High in Vitamin C include:

- blackcurrants
- kiwi fruit
- citrus fruits
- strawberries
- mangoes
- tomatoes
- peppers
- potatoes
- sweet potatoes
- pineapple

Once absorbed, iron is incorporated into red blood cells, muscle, enzyme systems and ferritin stores. Only a little is lost in faeces, sweat or urine.

DEFINITION OF IRON DEFICIENCY ANAEMIA (IDA)

In the early stages of iron deficiency, haemoglobin levels are not reduced even though the iron stores are being depleted. Then, as the bone marrow is starved of iron for red blood cell production, the red blood cell size and haemoglobin content decline. This leads to anaemia which is conventionally defined as a blood concentration of haemoglobin of less than 110 g/l (11g/dl).

It is important to remember that there are several causes of low haemoglobin other than simple dietary iron deficiency, such as iron malabsorption in diseases like coeliac disease, haemoglobinopathies (sickle cell disease and thalassaemia), the suppressant effect of recent infections on bone marrow red cell production and blood loss through intestinal bleeding. However, in toddlers, the most common cause of iron deficiency is a poor diet containing insufficient iron.



PREVALENCE OF IDA IN THE UK

Because of their relatively high dietary requirements, toddlers are particularly vulnerable to iron deficiency if they are not consuming appropriate iron rich foods. The National Diet and Nutrition Survey of 1995 found that around one in eight children aged 18 to 28 months had a low haemoglobin³. Various other surveys have reported that 25 to 35 per cent of ethnic minority and white young children from impoverished inner city areas of the UK have IDA⁵.

CAUSES OF IDA

Because the natural capacity of the body to absorb iron is limited and because there may be an insufficiency of iron-rich foods in the toddler diet, young children are at risk of iron deficiency after the age of six months unless their weaning diet is iron-sufficient. Infants who are exclusively breastfed beyond six months are at risk, as are infants given cows' milk rather than breast milk or infant formula before one year.

Toddlers need a high intake of dietary iron to achieve the RNI for iron between the ages of one and three years. This is not readily achieved and the National Diet and Nutrition Survey found that over 50 per cent of children of this age group had iron intakes below the RNI and 7 per cent had extremely low intakes (less than the Lower Reference Nutrient Intake of 3.7mg/day)⁴. [see Factsheet 1.1i](#) This is likely to be due to consumption of large volumes of cows' milk as the main food, and to weaning and family diets that are low in absorbable iron from meat sources⁶. Excessive amounts of cows' milk can cause anaemia not just because it contains little bioavailable iron, but also because it may cause microscopic bleeding from the gut.

Low intakes of meat have been noted among weaning infants and toddlers in families which eat halal meat. Until 2006 there were no commercial baby foods containing halal meat and these infants were often weaned almost exclusively on poor iron foods such as rice pudding and custard. Commercial weaning foods with halal meat are now available.

Toddlers with feeding behavioural problems are at particular risk of IDA especially if their diet is restricted to mainly cows' milk and sweet snacks. Careful management of these faddy eaters may overcome these problems. [see Factsheets 2.1, 2.2, 2.3](#) Additionally correction of iron deficiency, if present, may improve their fussy eating behaviour and poor appetite.



SYMPTOMS AND SIGNS OF IDA

Anaemia can cause general symptoms of pallor, lethargy and tiredness and, with increasing severity, breathlessness and heart failure. Such symptoms are fortunately uncommon in young children. However moderately low levels of haemoglobin, between 90 and 109 g/l, are frequently found in children at-risk and are associated with delays in cognitive and motor development and behavioural problems. Studies suggest that iron deficiency during a critical phase of early brain development can have long-lasting neuro-cognitive effects⁷.

Supplementary oral iron will usually correct the low haemoglobin of toddlers with IDA and may improve psychomotor development. The long-term developmental scores and school performance of these children can still be adversely affected⁷.

TREATMENT OF IDA

A simple fingerprick blood test can identify anaemia, which can be treated with an iron supplement (recommended dose: 3mg of iron/kg per day) and nutritional advice given to prevent recurrence. By ensuring the child consumes iron-rich foods and an iron supplement, the haemoglobin should rise by 10g/l per month if there is no other medical cause for anaemia other than poor diet. Treatment for two to three months should restore the iron stores and haemoglobin level. Failure to respond to such treatment should trigger investigations of alternative causes. Population-based blood screening has been advocated in communities with a high prevalence of iron deficiency⁵. However attendance at routine child health surveillance clinics in such communities is often low and children at greatest risk may be missed.



PREVENTION OF IDA

There are two approaches to preventing IDA in toddlers at risk:

- nutritional education of carers about foods that are rich in iron
- recommending iron fortified foods.

Each has its advantages and disadvantages and may be used alone or in combination.

Nutritional advice should include:

- Iron-rich foods at each meal. For example meat, oily fish, fortified breakfast cereals, lentils and green leafy vegetables combined with a source of vitamin C to aid absorption (see table page 6).
- Do not give cows' milk as the milk drink to infants under one year.
- Avoid excess volumes of milk drinks after one year of age and try to encourage three servings of dairy products per day, including milk, yogurt and cheese. This includes all milk drinks so that toddlers are drinking a maximum of about three milk drinks of 120mls per day. More than a pint of milk per day is too much.

Recommending iron fortified foods:

- Some breakfast cereals are fortified with iron. In addition, using iron-enriched milk formulas such as follow-on milks and growing up milks rather than cows' milk for toddlers can significantly reduce the prevalence of iron deficiency anaemia^{6,8}.

Foods that supply iron in toddlers' diets

Foods which contain easily absorbed iron.

- Breast milk
- Red meat - beef, lamb, pork, ham, bacon, sausages, burgers, corned beef, kidney
- White poultry meat - chicken and turkey. The dark meat from leg and thigh have higher amounts
- Liver and liver pate are good sources but should be limited to once per week because of their very high vitamin A content
- Oily fish - tuna, sardines, mackerel, pilchards, trout, kippers, salmon, fish paste, taramasalata

Foods that contain less well-absorbed iron. Therefore should be eaten with a source of vitamin C.

- Breakfast cereals with added iron
- Bread (white, brown, wholemeal), flour, pastry, chapatti, bread sticks
- Pulses - including chick peas, lentils, baked beans, peas and beans such as kidney and haricot. Also foods made from them such as hummus, dhal, onion bhajis and poppadoms
- Ground or chopped nuts, peanut butter, tofu*
- Egg yolk
- Dark green vegetables - broccoli, spinach, brussel sprouts, green cabbage, watercress
- Sweet potato, tomato, avocado
- Dried fruit including prunes, raisins, sultanas, dried apricots, dates
- Malt bread, dried fruit cake, ginger cake
- Digestive and ginger biscuits
- Chocolate, cocoa powder, chocolate spread
- Follow-on milks and growing up milks - they also contain vitamin C

*Keep in mind nut allergy. [see Factsheet 4.2](#)

These foods can be combined as suitable meals and snacks.

Breakfasts

- Breakfast cereals fortified with iron with milk and strawberries or orange segments
- Egg on toast with fresh fruit pieces

Light meals

- Liver pate in a sandwich or on toast
- Ham or other cold red meat sandwich
- Fish or meat paste sandwich
- Lean bacon sandwich
- Hot dog sausage in bread roll
- Taramasalata and pitta bread with citrus fruit segments
- Peanut butter sandwich and cherry tomatoes
- Hummus with bread sticks and slices of kiwi fruit
- Baked beans on toast with fingers of red pepper
- Onion bhajis with chapatti

Snacks

- Hummus dip with raw vegetable sticks
- Banana and orange segments
- Slice of fruit cake or dark ginger cake with segments of clementines
- Digestive biscuit with a handful of strawberries
- Slice of malt bread with slices of kiwi fruit
- Drinking chocolate made with follow-on or growing up milk

Main Meals

- Any meals with red meat or dark poultry meat
- Salmon and potato fishcakes with sautéed cabbage
- Dhal and chapatti with a slice of mango
- Stir fried tofu with spinach and sweet potato mash

Puddings

- Any puddings with dried fruit or crushed nuts along with segments of citrus fruit e.g. oranges or satsumas
- Dried fruit salad with orange segments
- Banana and kiwi fruit slices

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Additional copies of this Factsheet can be downloaded from www.infantandtoddlerforum.org

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IRON DEFICIENCY IN TODDLERS GUIDANCE AND TIPS FOR PARENTS



- It is important that toddlers get enough iron in their diet to prevent them from becoming anaemic. When toddlers are anaemic, the blood is unable to supply all the oxygen that the body needs.
- Symptoms and signs of anaemia include: looking pale, being tired all the time, irritable behaviour and suffering a lot of infections. Anaemia can also slow down your toddler's mental development.
- Foods from animals are the best source of iron, such as red meat (beef, lamb and pork), dark poultry meat (chicken legs and thighs), meat products, shellfish and oily fish. Liver is a good source of iron but should be limited to once per week because it contains high amounts of vitamin A.
- If your child does not eat meat you should include plenty of oily fish, cereal foods, crushed and finely ground nuts, lentils, dhal, chickpeas, hummus and other pulses along with green leafy vegetables and fruit in the diet.
- Vitamin C in fruit and vegetables helps the body to absorb iron from eggs, cereals and vegetable foods.
- Do not let your toddler drink tea with meals because this reduces the absorption of iron from foods.
- Toddlers who drink too much cows' milk every day and do not eat a healthy balanced diet may not get enough iron. After their first birthday about three cups of milk of 120mls (4oz) each per day is enough. Toddlers do not need large bottles of milk.
- Follow-on milks and growing up milks are fortified with iron. These can be used in place of cows' milk if you are worried that your toddler does not eat enough iron-rich foods.

Meals and snacks suitable for toddlers which are high in iron

Meals	Snacks
<ul style="list-style-type: none">• Liver pate sandwich or on toast• Any meals containing red meat or dark poultry meat• Fish or meat paste sandwich• Bacon sandwich• Hot dog sausage in bread roll• Taramasalata and pitta bread• Peanut butter sandwich with fruit pieces• Hummus and tortilla chips with two small tomatoes• Baked beans on toast with small green salad• Portion of dhal and chapatti with a slice of mango• Dried fruit with orange segments as the second course/pudding	<ul style="list-style-type: none">• Breakfast cereals fortified with iron with milk and fresh fruit slices• Drinking chocolate made with follow-on or growing up milk• Banana• Slice of fruit cake or dark ginger cake with orange segments• Digestive biscuit with a handful of strawberries• One slice of malt bread with fresh pineapple pieces

If you are concerned that your toddler might be anaemic or iron-deficient, seek advice from your health visitor or doctor.



Feeding young children:
practical advice from experts

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