Prevention and treatment of iron deficiency anaemia in children

Iron deficiency anaemia is a very common nutritional disorder.

DEBORAH JACOBSON, ***BSc (Hons), Chem BSc (Med)(Hons) Dietetics, RDSA***
Dietitian in private practice, Johannesburg

Deborah has a special interest in paediatrics. She has practices in Bedford Gardens, Garden City, Houghton, Glenhazel and Sunninghill. She manages nutritional requirements for children and infants in hospital (ICU and general wards). She also consults with outpatients.

Iron deficiency (ID) is the most common nutritional disorder in the world, affecting over one billion people, particularly women of childbearing age and preschool-aged children. At least half of the anaemia worldwide is directly due to dietary ID. Factors contributing to ID include diets low in iron, reduced iron availability, increased iron requirements to meet growth demands, and losses due to parasitic infections. These factors often operate concurrently.

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It is well established that iron deficiency anaemia (IDA) in infants and children leads to reduced performance, diminished attention, memory loss, learning disability and growth retardation. Delays in development can vary from apathy to extreme listlessness. Most learning disabilities lead to slowed development. However, ID that is not severe enough to cause anaemia is also related to reduced performance and diminished learning ability. ID has also been associated with frequent infections.[1] The developmental deficits to some extent can be corrected with iron treatment, but there is also evidence that some deficits are not reversible with iron treatment. Irreversible developmental delay in children and the fact that iron is needed continuously throughout the entire period of brain growth are strong arguments for active and effective combating and prevention of ID.

South African statistics

The latest South African statistics show that 5.1% of children aged 1 - 5 years had IDA and that 7.3% of perinatal deaths were attributed to IDA in 2000.[2]

The 1999 National Food Consumption Survey (NFCS) in South Africa was a large cross-sectional survey of a nationally representative sample. This found that the mean intake of iron was consistently low in all age groups; 36 - 57% of children had an iron intake of less than two-thirds the RDA. There was no difference in gender. Children of all age groups living in urban areas had a significantly higher intake of iron than children living in rural areas. At a national level, the survey indicated that the most commonly consumed foods were maize, sugar, tea, whole milk and brown bread.

A recent study found that 33% of rural children between 2 and 5 years were iron deficient.[3] Faber *et al.* found 43.2% of rural children aged 4 - 24 months were iron deficient.[4] A study that took place in disadvantaged communities in the Western Cape showed 32% of coloured infants and 46% of black infants had IDA.[5]

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ID and IDA are major problems in HIV-infected children in South Africa. Eley *et al.* found that 52% of HIV-infected children were iron-depleted, 20% had iron-deficient erythropoiesis and 18% had IDA.[6]

Perez *et al.* found that IDA altered mother-child interactions at both 10 weeks and 9 months postpartum. Infants whose mothers were anaemic in the early postpartum period scored worse on developmental tests at these two stages.[7] Interestingly, ID seems to exacerbate the prenatal alcohol effects on growth.[8]

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Who is at risk?

- **Preterm or low-birth-weight infants.** The amount of stored iron an infant is born with depends on its size. On average, the iron store in a full-term infant meets the infant's iron requirement until 4 - 6 months. Low-birth-weight infants are at risk of early ID because their iron store is lower.
- Children who are strict **vegetarians.** All dietary iron in a vegetarian diet is from non-haem sources and the intake of phosphates, oxalates and phytates, known to reduce iron absorption, is high.
- Children suffering from a **chronic disease.**
- Infants of **iron-deficient mothers.** ID during pregnancy is related to maternal and fetal mortality and premature delivery. It has been found that infants of mothers with moderate to severe anaemia at 37 - 41 weeks of pregnancy had significantly lower cord serum ferritin levels and hence poor iron stores at birth.
- Infants who are weaned **inappropriately.**
- Infants who are weaned **late.**
- Infants and children who are **failing to thrive.**

Iron absorption

Three factors determine the amount of iron absorbed from the diet (Table I):

- the amount of dietary iron ingested – the most common reason for ID
- the iron status of the child
- the bio-availablity of iron consumed.

Foods containing low bio-availability iron (non-haem) include plant protein sources (e.g. maize-meal and bread) and vegetables. The bio-availability of iron from these foods is further diminished when consumed with tea or coffee at meal times. Vitamin C (ascorbic acid) is a potent enhancer of non-haem iron. When eating foods containing non-haem iron, a vitamin C-containing food should be included in the meal.

Common causes of iron deficiency anaemia in children

- Early introduction and excessive use of cow's milk. Cow's milk should only be introduced at 1 year and approximately 500 ml per day.
- Excessive intake of juice – leaving no space for adequate food intake.
- Prolonged bottle feeding.
- Late weaning onto foods with low iron content.
- Sensitivity to cow's milk protein can result in gastrointestinal occult blood loss.
- Parasitic infection can cause gastro-intestinal blood loss.
- Gastrointestinal disorders such as peptic ulcer and inflammatory bowel disease.
- Often related to poor appetites.

Prevention

- Infants should be given breastmilk or iron-fortified infant formula. About 50% of iron in breastmilk is absorbed compared with about 10% of iron in ordinary cow's milk.
- Low-iron formula, iron-free formula or unfortified goat's milk should not be used.
- Infants need an additional source of iron (apart from breastmilk or fortified formula) by 4 - 6 months (approximately 1 mg/kg/day). Iron-fortified cereals are a good source of iron for initial introduction of iron-containing food. An average of 2 servings (15 g per serving) of dry cereal is needed to meet their daily requirement.
- If an infant is unable to consume sufficient iron from dietary sources after 6 months, elemental iron (1 mg/kg/day) can be used.
- Low-birth-weight infants should receive 2 - 4 mg/kg/day. The amount of supplementation depends on the weight of the infant at birth and the type of feed that is being used.
- Do not introduce juice – encourage water. If juice is necessary, allow only 1 cup (250 ml) per day of diluted juice.
- Give appropriate amounts of milk (500 - 700 ml per day) after 1 year. Excessive intake of milk should be discouraged.
- Introduce haem sources of iron at 6 months (strained meat). The iron in haem iron sources of foods is absorbed about 2 - 3 times more efficiently than non-haem iron food sources.
- Combine non-haem sources of iron with vitamin C-rich foods (see Table II) at meal times.
- Tea and coffee: only rooibos tea should be given (no regular tea or coffee) – about 1 cup (250 ml) per day.
- When a child is able to chew and swallow well, animal protein (red meat, poultry or fish) should be eaten daily. If they are not able to include this in their diet and they do not eat iron-fortified cereals, a daily iron supplement should be considered (based on the DRI – Table III).

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Table I. Factors affecting iron absorption

Inhibitors	Enhancers
High phosphorous foods form insoluble ferric phosphate – e.g. bread, cereals, milk	Vitamin C – citrus fruits, peppers, vegetables, strawberries, melon, mango, tomatoes, papaya
Phytic acid – in some wholegrain foods like cereals, soybeans	An unknown component in meat
Carbonates – carbonated beverages	Sulphydryl groups of proteins – animal protein
Oxalates – e.g. raw spinach, rhubarb	
Tea and coffee – discourage drinking during meal times	

Table II. Sources of iron

Haem iron	Non-haem iron – ferric iron complexes
Lives and organ meats	Cereals (grains)
Seafood	Vegetables
Lean red meat	Dried beans/legumes
Poultry	

Table III. Dietary iron requirements (DRI) dietary reference intake (2001)

Dietary iron	Requirement (mg per day)
Infants	11
Children 1 - 3 years	7
Children 4 - 8 years	10
Children 9 - 13 years	8

Management

Management includes improved dietary intake (see above), gastrointestinal examination and oral supplementation. ID should be suspected if the child has a poor appetite, irregular sleep patterns and a tendency towards bouts of irritability.

Iron supplementation

To enhance absorption, iron supplementation should be taken between meals and at different times to other vitamin and mineral supplementation.

- **Premature infants** less than 1.5 kg: 2 - 3 mg per kg. Supplementation should occur once the child is stable and without infection. The supplemental dose is 2 - 3 mg per kg up to a maximum of 15 mg per day.

ID should be suspected if the child has a poor appetite, irregular sleep patterns and a tendency towards bouts of irritability.

This should continue until the end of the first year. However, if infants drink sufficient quantities of appropriate formula, this may not be necessary. Excess iron is associated with risk of bacterial infection and haemolysis if vitamin E is inadequate.

- **Infants** 5 -10 kg: 25 mg per day.
- **Children 2 - 6 years:** 50 mg per day or 3 - 5 mg/kg/day.
- **Children 6 - 12 years:** 50 -100 mg per day or 3 - 5 mg/kg/day.

References

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In a nutshell

- Iron deficiency anaemia is the most common nutritional disorder worldwide.
- In South Africa 5.1% of children 1 - 5 years had IDA in a 2000 survey.
- In the same survey 36 - 57% of children had inadequate dietary iron intake.
- The most common reason for iron deficiency is inadequate dietary iron intake.
- Infants with low birth weight and with iron-deficient mothers are at high risk of developing IDA.
- Infants who are weaned onto solid foods inappropriately have high risk of developing IDA.
- IDA in children leads to reduced cognitive, behavioural and growth performance.
- Correct eating practices in infancy can prevent IDA.
- Early introduction and excessive use of cow's milk is a common cause of IDA in young children.
- Vitamin C is an important enhancer of non-haem iron absorption.

Single Suture

Insulin can help in Alzheimer's disease

Sniffing insulin would seem to improve cognitive function in those with Alzheimer's disease, according to a study published in *Neurology.* A pilot study of 25 patients who were randomly assigned to receive either placebo or insulin found that although blood glucose concentrations remained unchanged, patients who were given insulin retained more verbal information after a delay and had better concentration than those who received a placebo.

Insulin-like peptides take only 15 minutes to follow extracellular pathways to the brain after being sniffed.

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