Editorial

Iron deficiency in children: food for thought

Many Australian children are at risk of iron deficiency and long term neurocognitive impairment

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Iron deficiency is the most common nutritional deficiency worldwide. Iron depletion and deficiency and, less commonly, iron-deficiency anaemia (defined in the Box) are prevalent in all age groups, but particularly in infants, the elderly and women after the onset of menses, and also in socioeconomically deprived populations, such as refugees and recent migrants.

Infancy is the critical period for brain growth, and nutrient deficiencies during this time may affect psychomotor development and neurocognition. Iron-deficient infants are often apathetic, listless, irritable and anorexic. These symptoms resolve rapidly with iron supplementation, but less well known is the fact that long term neurocognitive impairment may persist.[1,2] Young children with iron-deficiency anaemia have been found to score 12 to 15 points lower on the Bayley infant development scale than their iron-sufficient peers.[3] Prolonged iron supplementation improved these scores and other performance parameters, such as fine motor and discriminative skills, but did not produce complete resolution despite an excellent haematological response.[4]Persisting deficits in a variety of psychometric tests have also been shown both in five-year-olds in Chile and 10-year-olds in Costa Rica who were iron deficient in infancy,[1,5] but there are no convincing data on long term outcome in adult life. In older children with iron deficiency (eg, teenage girls), iron supplementation can also improve neurocognitive performance.[6]

Therefore, although no studies have established a direct causal relationship between iron deficiency and performance, it is prudent to prevent iron depletion and, if present, to treat it until iron status is normal.

Australian paediatricians have long been aware that populations who have recently migrated, such as the Vietnamese, as well as refugees from most of the world's troublespots and Indigenous populations, have a high prevalence of iron deficiency. In this issue of the Journal, Karr and colleagues report on the iron status of a group of Sydney children whose mothers were born in an Arabic-speaking country.[7] In this group of 403 children aged 12-38 months, prevalence of iron-deficiency anaemia was 6%, iron deficiency without anaemia 9%, and iron depletion 23%. These levels are disturbing. Similar results have been found among children of South East Asian descent in Adelaide, South Australia.[8] Although most children with iron depletion will suffer no long term harm, they should be viewed as part of a continuum, with children with iron-deficiency anaemia at greatest risk of not achieving

their full intellectual potential. Most of these children have no other nutritional deficiency and, indeed, are often obese.

The risk factors for impaired iron status identified by Karr and colleagues were similar to those seen in other countries, and include prematurity, excessive consumption of cows' milk and recent maternal immigration. However, the mechanisms by which these risk factors contribute to iron depletion are explored only superficially by Karr and colleagues, and no convincing strategies to correct iron depletion were espoused other than provision of Arabic interpreters at early childhood health centres.

Some of the reasons the identified risk factors contribute to iron depletion are as follows. Prematurity results in inadequate iron accrual. Cows' milk is deficient in iron and in young infants causes occult microscopic blood loss from the colon. Recent maternal immigration may be linked to poverty, and these children may consume excessive amounts of cows' milk because it is cheap and readily available. Recent immigrant mothers may also have inadequate iron stores, resulting in diminished iron stores in their babies. Once children become iron deficient, they become very restricted in the range of foods they will accept. Appetite and tolerance of new or previously discarded foods improves with iron repletion.[9]

Furthermore, maternal iron deficiency results in large placental size and small babies whose iron stores are insufficient to sustain them through rapid early growth.[10] The currently fashionable "Barker hypothesis" states that health outcomes in later life are programmed by intrauterine events. Infants who are small for gestational age tend to have worse adult outcomes and are more likely to develop insulin resistance and hypertension. Maternal iron deficiency may conceivably result in yet to be recognised consequences in adult life.

Medical practitioners should try to ensure that children and women of childbearing age are iron replete. Commonsense dictates that, because of the concern over persisting neurocognitive deficits, it is much better to prevent iron deficiency in the community than to treat it case by case. Although it is tempting to view iron depletion as a problem of disadvantage, many other children are at risk.

We therefore recommend that:

- Young children of high-risk ethnic groups, survivors of prematurity and children with excessive cows' milk consumption or prolonged breast-feeding (breast milk is very low in iron) should have a full blood examination and iron studies, including measurement of ferritin levels.
- Any developmentally delayed child should be screened for iron status. In addition, children with breath holding may be iron deficient, and breath holding may improve substantially following iron supplementation.[11]

- Iron-depleted children should receive full supplementation of elemental iron at a dose of 6 mg/kg per day for about two to three months, when the iron studies should be repeated. Commercial iron preparations are relatively unpalatable, and it is often difficult to enforce prolonged therapy. Iron absorption is enhanced if supplements are administered with a vitamin C source, such as orange juice. Parents should be warned that bowel motions are often black and that this does not denote ill-health. Dietary advice about iron-rich foods should also be offered.
- Protocol advice for iron deficiency should be incorporated into the early years program currently being promoted by the Commonwealth Department of Health and Aged Care and the Royal Australasian College of Physicians, which concentrates on optimising intellectual and social outcomes with interventions aimed at infants.

Some countries, not including Australia, recommend iron supplementation in infancy. The most effective measure on a global scale to prevent iron deficiency has been fortification of infant formula with iron, and currently all breast-milk substitute formulas in Australia are iron fortified. This intervention is most effective in the first year of life, but does not address the problem of infants who are exclusively breastfed and children with a large intake of cows' milk. All infants should have iron-rich foods, particularly red meat, introduced shortly after six months of age.

A dietary program aimed at improving iron status in Australian mothers and children would benefit both individuals and society as a whole. The high incidence of iron-deficiency anaemia in this cohort of Australian children of Arabic background and its known association with persisting neurocognitive deficits should provide Australian health planners with food for thought.

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Definitions of impaired iron status

Iron depletion: Low iron stores but no change in haematological parameters.
Iron deficiency: Low iron stores and reduced mean cell volume but normal haemoglobin concentration.
Iron-deficiency anaemia: Low iron stores, reduced mean cell volume and reduced haemoglobin concentration.

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