

## DECISIONS

## Iron deficiency in early childhood

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An 18-month-old girl is seen by her family physician for her 18-month check-up. Her weight and height are at the 50th percentile. She was breastfed in the first year, introduced to complementary (i.e., solid) foods at 6 months and cow's milk at 12 months, and currently drinks 1 L of cow's milk per day by bottle. Her parents describe her as a fussy infant who has never eaten solid foods well and has poor meat and vegetable intake. They ask if she should take a vitamin and mineral supplement.

**Is the child at risk for iron deficiency?**

As a healthy term infant, this child was born with sufficient iron stores for the first 4 to 6 months. However, at her age, she is at risk for iron deficiency, which peaks in prevalence during the toddler years (1–3 yr).<sup>1</sup> Although there are no nationally representative data, small regional studies suggest a prevalence among young Canadian children of 12% or higher for nonanemic iron deficiency and 1.5% or higher for iron deficiency anemia.<sup>2</sup> In addition, she has several dietary risk factors (Box 1), including prolonged bottle use, excessive consumption of cow's milk and poor intake of iron-rich complementary foods.<sup>1,3–5</sup> Should this child have iron deficiency, she would be at risk for poor cognitive development, which has been shown in animal studies, observational studies and randomized trials.<sup>6,7</sup>

The role of screening and prevention for iron deficiency remains unclear. In a consensus statement, the American Academy of Pediatrics recommends the following: that universal screening be employed to identify anemia at 12 months of age using risk assessment and laboratory tests, that exclusively and partially breastfed infants receive 1 mg elemental iron/kg daily beginning at 4 months of age until iron-containing complementary foods are introduced, and that preterm breastfed infants receive 2 mg elemental iron/kg daily by 1 month of age until weaned to iron-fortified formula or beginning complementary foods.<sup>1</sup> There is no Canadian recommendation for routine screening or iron supplementation.<sup>8</sup>

**What investigations, if any, should be ordered?**

On clinical examination, this child does not have pallor. However, in a meta-analysis, the diagnostic accuracy of pallor (i.e., conjunctival, palmar or nail bed) was shown to be poor until anemia is severe (i.e., hemoglobin level < 50 g/L).<sup>9</sup> Considering this child's age and risk factors, laboratory testing, including hemoglobin, serum ferritin and C-reactive protein levels, is indicated.<sup>1</sup> Based on the results (hemoglobin 87 g/L, serum ferritin 6 µg/L and C-reactive protein < 8.0 mg/L), the child has iron-deficiency anemia. In children aged 1–3 years, iron deficiency anemia is defined as a hemoglobin level of less than 110 g/L along with a measure of iron deficiency, such as a serum ferritin level of less than 14 µg/L, whereas nonanemic iron deficiency is defined as iron deficiency with a hemoglobin level of 110 g/L or higher.<sup>10</sup> The American Academy of Pediatrics recommends simultaneously measuring C-reactive protein.<sup>1</sup> If the C-reactive protein level is elevated (> 8.0 mg/L), the serum ferritin level (an acute phase reactant) may be falsely elevated, and thus the laboratory results should be interpreted with caution.<sup>1</sup> Reticulocyte hemoglobin and transferrin receptor 1 are promising new tests of iron status.<sup>1</sup>

**Competing interests:** None declared.

This article has been peer reviewed.

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**CMAJ 2013. DOI:10.1503/cmaj.130150**

**Box 1: Risk factors for iron deficiency in early childhood<sup>1,3–5</sup>**

- Prematurity
- Low birth weight
- Infants born to iron-deficient mothers
- Bottle use beyond 12–15 mo
- Exclusive breastfeeding beyond 6 mo
- Longer total breastfeeding duration
- Excessive cow's milk (> 500 mL/d)
- Early introduction of cow's milk (before 12 mo)
- Diet poor in iron-rich complementary foods
- Feeding problems
- Poor growth, including obesity
- Low socioeconomic status

### What treatment should the child receive?

A Cochrane systematic review identified 2 randomized placebo-controlled trials of 2 and 4 months duration suggesting improved psychomotor development following iron therapy.<sup>7</sup> The American Academy of Pediatrics report recommends that children with iron deficiency anemia be given 6 mg/kg/d elemental iron (ferrous fumarate or sulfate), orally as a single dose or divided into 2 or 3 doses, for 4 months.<sup>1</sup> Additionally, the child's parents should receive dietary advice regarding foods that are rich in iron and contain vitamin C, and diet practices that prevent iron deficiency (Box 2).<sup>1,3-5</sup> For children with non-anemic iron deficiency, dietary advice is recommended;<sup>1</sup> it is not known whether the addition of oral iron is superior to dietary advice alone.

### What follow-up is needed?

This child may experience difficulties with adherence because of the poor palatability of oral iron and should be monitored closely. To confirm the diagnosis and ensure adherence, she should have a repeat measurement of hemoglobin and serum ferritin 4 months after treatment is started or earlier if there are concerns about adherence.<sup>7</sup> She should undergo developmental screening and be referred for developmental assessment if there is evidence of delay.

### Case resolution

The child's parents received dietary advice, and she was given oral iron for 4 months. No concerns were identified on developmental screening. Her

parents reported good adherence, improved diet and dietary practices, and improvement in her fussy behaviour. At 4 months after initiation of iron, repeat blood tests showed a hemoglobin level of 112 g/L and serum ferritin level of 32 µg/L. Iron was discontinued. She remained adherent to the dietary recommendations and showed appropriate growth and development. No further blood tests were ordered.

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**Contributors:** Both authors drafted and revised the article, and gave final approval of the version submitted for publication.

#### Box 2: Dietary advice for children aged 12 to 36 months to prevent or treat\* iron deficiency<sup>1,3-5</sup>

##### Foods rich in iron

- High: meat and eggs
- Medium: meat alternatives (e.g., beans, tofu)
- Lower: grain products (e.g., oatmeal, enriched pasta, enriched rice), vegetables and fruit (e.g., broccoli, spinach, prune juice)

##### Foods containing vitamin C that increase iron absorption

- Fruits: citrus fruits (e.g., oranges, grapefruit) and juices, tomatoes, cantaloupe, kiwi
- Vegetables: leafy greens (e.g., spinach, cabbage), cauliflower, broccoli, Brussels sprouts, green and red peppers

##### Dietary practices that prevent iron deficiency

- Limit cow's milk to 2 to 3 cups (500–750 mL) per day
- Limit juice to 1/2 to 3/4 cup (125–175 mL) per day
- Cow's milk, juice and water should be offered from an open cup, and baby bottles should be discontinued when the child is 12–15 months of age or preferably earlier
- Ensure iron-rich and vitamin C-containing foods for infants breastfed beyond 6 months
- Do not give tea, which impairs iron absorption

\*Iron deficiency anemia should be treated with oral iron plus dietary advice.

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