Selected Micronutrient Needs of Children 1–3 Years of Age

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Children 1–3 years of age are among the most nutritionally understudied population. Most recent studies, especially on minerals, have used stable isotopes to assess nutrient absorption and metabolism [1]. This methodology relies on the incorporation of an orally administered iron isotope (often given with an enhancer of iron absorption such as vitamin C or with a meal) into red blood cells at 14–28 days. For zinc, calcium, and magnesium, the preferred technique is the dual tracer study in which one isotope is administered orally and a second is given intravenously with primary analysis being done of the ratio of the recovered isotopes in the urine.

Iron and Zinc

The requirements for iron have been set using a factorial approach in which the mean need of toddlers is about 0.6 mg absorbed iron per day and the 97th percentile of requirement is 1.2 mg/day. The US Dietary guidelines then used an approximate absorption fraction of 18% to calculate an estimated average requirement (EAR) of 3 mg/day and a recommended dietary allowance (RDA) of 7 mg/day.

Comparing these values to usual intakes on a global basis, it appears that the mean intake of iron in the USA, Mexico, Europe, and Australia is about 7–10 mg/day, consistent with most children in these locations being well above the EAR. In contrast, lower intake with a mean of about 5 mg/day was reported in the Philippines. Of concern is that the prevalence of anemia remains very high globally with large differences between regions ranging from about 20 to nearly 70% (Table 1) [2, 3].

The EAR for zinc has been set as 2.5 mg/day in the USA/Canada and the equivalent value of 3.6 mg/day in Europe. The RDA for zinc has been set for this age group at 3 mg/day in the USA/Canada and 4.3 mg/day for Europe. Regardless of the exact EAR recommended, the EAR is well below the usual intakes in the USA and Mexico of about 6–8 mg/day.
Calcium, Vitamin D, and Magnesium

Dietary requirements of calcium have largely been set in childhood based on the usual rate at which the skeleton accretes calcium. Estimates based largely on bone mass data suggest this rate in toddlers is about 100 mg/day on average. The EAR in the USA and Canada is 500 mg/day and the RDA 700 mg/day in this age group. Usual intakes in the USA are well above both of these values [4]. Key issues related to vitamin D are the use of national strategies related to food fortification and/or supplementation strategies. These may be most likely considered in countries in which 20% of the population at risk has a 25-OHD level below 30 nmol/L and/or a >1% prevalence of rickets [5]. This is consistent with a Cochrane review suggesting that supplementation of deficient children (< approximately 35 nmol/L) may be useful. The persistence of clinical rickets in many parts of the world is consistent with careful vigilance. The importance of magnesium is increasingly recognized in all age groups. We found that an intake of about 100 mg/daily led to a net calcium retention of about 20 mg/day in toddlers. However, it is likely that 20 mg/day slightly exceeds the average typical magnesium retention in this age group. The EAR for magnesium was set at 65 mg and the RDA of 80 mg/day before our study. The 1st percentile of usual intakes is 80 mg/day, and the median intake is 180 mg/day. These data suggest limited population-based concern in the USA related to magnesium dietary sufficiency.

Table 1. Summary of key current considerations for minerals in toddlers

- In industrialized countries, iron intake for most small children matches published requirements. This is less true for nonindustrialized countries, and significant shortfalls and anemia persist in all locations.
- Generally, zinc intakes are well above recommendations for most toddlers. As with iron, this is truer in industrialized settings. The likely average physiological need is about 300–400 mg/day.
- Calcium requirements are easily achieved with diet that includes dairy or fortified plant-based or other beverages. Breastfed toddlers should have adequate solid food or other dietary sources of calcium.
- Related to bone health, there is a low but definite persistence of severe vitamin D deficiency in this age group in most countries, since dietary intakes are low in many populations.
- Magnesium-deficient intake is likely relatively uncommon with mixed diets and difficult for clinicians to assess.
References