

# Pediatric Pharmacotherapy

## A Monthly Review for Health Care Professionals of the Children's Medical Center

Volume 3, Number 4, April 1997

## Vitamin and Mineral Supplement Requirements of Healthy Children in the United States

Clara Jane Snipes, R. Ph.

- [Introduction](#)
- [Government Regulations](#)
- [Products Available](#)
  - [Table I: examples of pediatric vitamin products](#)
- [Guidelines for Supplementation](#)
  - [newborn infants](#)
  - [breast-fed infants](#)
  - [formula-fed infants](#)
  - [preterm infants](#)
  - [older infants](#)
  - [children and adolescents](#)
- [Conclusions](#)
- [References](#)

### Pharmacology Literature Reviews

- [Ceftriaxone in infants](#)
- [Macrolide Review](#)
- [New Antifungal Agents](#)

### [Formulary Update](#)

---

Vitamin and mineral supplements are relatively inexpensive and available without prescription; therefore, they are used by a substantial proportion of the United States population.<sup>1-4</sup> A growing public awareness of the role of vitamins and minerals in human nutrition is fostered by a combination of advertising pressure and concern about dietary adequacy. Many people regard vitamin and mineral supplementation as a reliable method of ensuring dietary shortcomings are corrected.

Previous studies have shown that 50% of children less than two years of age in the United States receive multivitamins and 25% of children ages 11 to 19 years receive periodic supplementation.<sup>3</sup> PARENTS magazine advises parents that it is reasonable to give children a vitamin and mineral supplement three or four times weekly, particularly if they are finicky eaters.<sup>4</sup>

In reality, most children get the nutrients they need from the foods they eat and the milk they drink. As a result, the American Academy of Pediatrics does not recommend vitamin and mineral supplements for healthy children who follow a well-balanced, varied diet.<sup>2</sup>

This article will focus on the use of vitamin and mineral supplements in healthy infants and children in the United States. The needs of special pediatric populations, such as preterm infants and breastfed infants of malnourished mothers, will be briefly covered.

## **Government Regulations**

Vitamin and mineral supplements currently available in the United States for infants and children less than four years old must meet the Food and Drug Administration (FDA) regulations for content.<sup>1</sup> Preparations for older children and adults are not subject to FDA regulations.

The Food and Nutrition Board of the National Academy of Sciences, National Research Council periodically publishes Recommended Dietary Allowances (RDAs) for vitamins and minerals. Using these values, the FDA establishes reference figures for the labeling of foods and supplements in the United States. RDAs are established for three groups: infants, children one to four years old, and adults and children four or more years old. The latter category is further divided according to gender.

The contents of vitamin and mineral supplements range from the lower limits (considered sufficient to minimize the risk of deficiency) to the upper limits (estimated to fully meet nutritional needs without excess) of the RDA guidelines. In most preparations, the lower limits for individual nutrients are 25 to 50% of the RDA and the upper limits are 100 to 150% of the RDA values.<sup>1</sup>

## **Products Available**

Combination products predominate in this therapeutic class; individual vitamins are rarely used. Exceptions include the administration of vitamin K and vitamin E in infants. Iron is the only mineral supplement commonly used. It may be administered alone or in combination with vitamin supplements.<sup>1,5</sup>

The products on the market for infants and children can be categorized as either liquids or chewable tablets.

For infants, the most commonly used liquid formulations are those containing vitamins A, D, and C with or without iron (e.g. Tri-Vi-Sol®). Combinations are also

available which include additional thiamin, riboflavin, niacin, and pyridoxine (e.g. Poly-Vi-Sol® ). Folic acid is omitted from these products due to its instability in the liquid form.

For older children, chewable tablets are often preferred. These products typically contain vitamins A, D, and C as well as the B vitamins and minerals. Folic acid is routinely included in these products.<sup>6</sup>

The foregoing combination products are available with fluoride for infants and children residing in areas where the water is not fluorinated. Supplements containing 0.25, 0.5, or 1.0 mg fluoride per dose are available by prescription. Numerous pediatric products are currently on the market, including both well-recognized brand names and less expensive generic or store brands. Several products are available in sugar or dye-free forms.<sup>7</sup> A sampling of products available from pharmacies in the Charlottesville area and their average cost is provided below.

**Table I: Examples of Pediatric Vitamin Products**

Product	Manufacturer	Cost
<b>Liquids</b> Poly-Vi-Sol®	Mead Johnson	\$9.99/50 ml
Tri-Vi Sol®	Mead Johnson	\$9.15/50 ml
<b>Chewables</b> Centrum Jr.® <sup>a</sup>	Lederle	\$6.49/60 tab
Sesame Street Complete® <sup>a</sup>	Johnson and Johnson	\$6.29/60 tab
Bugs Bunny Complete® <sup>a,b,c</sup>	Bayer	\$5.99/60 tab
Flintstones Complete® <sup>a,b,d</sup>	Bayer	\$6.99/60 tab
CVS Children's Multivitamin®	CVS	\$3.99/100 tab
Phar-Mor Children's Chewables®	Phar-Mor	\$3.98/100 tab

- a also available with additional vitamin C or iron
  - b also available with additional calcium
  - c sugar-free
  - d also available with beta-carotene
- 

## **Guidelines for Supplementation**

### **Newborn Infants**

The administration of vitamin K minimizes the postnatal decline of the vitamin K-dependent coagulation factors (II, VII, IX, and X) and is therefore an effective prophylaxis against hemorrhagic disease of the newborn. Vitamin K should be given as a single, intramuscular dose of 0.5 to 1.0 mg. Vitamin K prophylaxis for newborn infants is mandated by law in Virginia.

### **Breast-fed Infants**

The maternal diet strongly influences the concentration of certain water-soluble vitamins in human milk. Vitamin B<sub>12</sub> deficiency has been reported in breast-fed infants of strict vegetarian mothers. The healthy, breast-fed, term infant of the well-nourished mother has not been shown conclusively to require any vitamin or mineral supplementation, provided the infant has adequate exposure to sunlight. The benefit of fluoride supplementation in the breast-fed infant is controversial. Research shows that unerupted teeth are mineralized in early infancy. The Committee on Nutrition favors initiating fluoride supplements shortly after birth in breast-fed infants but acknowledges that fluoride supplementation could be initiated at six months of age.

### **Formula-fed Infants**

Infants who consume appropriate amounts of commercial infant formulas which are within the recommendations of the Committee on Nutrition do not need vitamin and mineral supplementation in the first six months of life. Furthermore, they do not need supplements during the second six months of life if formula continues to be used in appropriate combination with solid foods. After four months of age, iron-fortified formula and/or cereal are convenient sources of iron and are preferable to the use of iron supplements.

If powdered or concentrated formula is used, fluoride supplements should be administered only if the community water contains less than 0.3 ppm of fluoride. Ready-to-use formulas are manufactured with water low in fluoride, and recommendations for fluoride supplementation should be comparable to those for breast-fed infants.

## **Preterm Infants**

The needs of preterm infants for vitamins and minerals are proportionately greater than those of term infants because of the increased demands of a more rapid growth rate and less complete intestinal absorption.

During the first weeks of life (prior to consumption of about 300 kcal per day or reaching a body weight of 2.5 kg), a multivitamin supplement that contains the equivalent of the RDA's for term infants should be supplied. Recommended products include Poly-Vi-Sol® and Tri-Vi-Sol® or their generic equivalents. Iron supplementation is best delayed until after the first few weeks of life because extra iron may predispose to anemia when there is insufficient absorption of vitamin E. Neonatal stores of iron are sufficient for erythropoiesis during this time.<sup>1</sup>

After the infant is consuming greater than 300 kcal per day or when the body weight exceeds 2.5 kg, a multivitamin supplement is no longer needed. However, supplementation may be a convenient method to provide the few specific nutrients, such as vitamin D and iron, that still may be required.<sup>1</sup>

## **Older Infants**

During the second six months of life, the healthy infant, on a diet of formula, iron-fortified cereal and increasing amounts of table food, does not require additional supplements of vitamins and minerals.<sup>1</sup> It is important, however, that the diet include an adequate source of vitamin C. Infants at special nutritional risk as a result of lifestyle, economic disadvantage, or illness may benefit from vitamin and mineral supplementation.

## **Children and Adolescents**

There is little evidence to support routine vitamin and mineral supplementation in healthy children and adolescents maintained on a well-balanced, varied diet.<sup>8-10</sup>

However, when supplements are indicated, the contents should provide these nutrients at RDA levels. Groups at particular nutritional risk include:

1. children and adolescents from deprived families due to an insufficiency of food,
2. children and adolescents who have poor appetites or who consume fad diets,
3. children and adolescents consuming vegetarian diets without adequate dairy products may need vitamin B<sub>12</sub> and vitamin D supplementation,
4. children and adolescents with chronic illness, such as cystic fibrosis.<sup>11</sup>

## **Conclusions**

The combination of vitamins A, C, and D for infants was originally developed to complement home-prepared formulas. With the advent of improved commercial

infant formulas and the increasing popularity of breastfeeding, there is no evidence that additional vitamin and mineral supplementation is necessary.<sup>1</sup> Similarly, there is little basis for routine supplementation in properly nourished, healthy children. However, it should be noted that a recent survey from the United States Department of Agriculture showed that nearly one quarter of all vegetables consumed by children and adolescents were french fries.<sup>12</sup> Pediatricians should continue to encourage the consumption of fruits and green and yellow vegetables by children and adolescents, rather than reliance upon supplements.<sup>13</sup>

## References

1. American Academy of Pediatrics. Pediatric Nutrition Handbook. 2nd ed. Elk Grove: American Academy of Pediatrics. 1985.
2. Curtis DM. Infant nutrient supplementation. *J Pediatr* 1990;117:S110-8.
3. Looker AC, Sempos CT, Johnson CL et al. Comparison of dietary intakes and iron status of vitamin-mineral supplement users and nonusers, aged 1-19 years. *Am J Clin Nutr* 1987;46:665-72.
4. Anon. Parents Magazine. July 1995.
5. Filer LJ. Iron needs during rapid growth and mental development. *J Pediatr* 1990;117:S143-6.
6. Udall JN, Greene HL. Vitamin update. *Pediatr Rev* 1992;13:185-94.
7. Kumar A, Aitas AT, Hunter AG et al. Sweeteners, dyes, and other excipients in vitamin and mineral preparations. *Clin Pediatr* 1996;35:443-50.
8. Bowering J, Clancy KL. Nutritional status of children and teenagers in relation to vitamin and mineral use. *J Am Diet Assoc* 1986;86:1033-8.
9. Nelson M. Vitamin and mineral supplementation and academic performance in schoolchildren. *Proc Nutr Soc* 1992;51:303-13.
10. Cook CC, Payne IR. Effects of supplements on the nutrient intake of children. *J Am Diet Assoc* 1979;74:130-3.
11. Borowitz D, Wegman T, Harris M. Preventive care for patients with chronic illness. Multivitamin use in patients with cystic fibrosis. *Clin Pediatr* 1994;33:720-5.
12. Krebs-Smith SM, Cook A, Subar AF et al. Fruit and vegetable intakes of children and adolescents in the United States. *Arch Pediatr Adolesc Med* 1996;150:81-6.
13. Albertson AM, Tobelmann RC, Engstrom A et al. Nutrient intakes of 2- to 10-year-old American children: 10-year trends. *J Am Diet Assoc* 1992;92:1492-6.

The author and editors of *Pediatric Pharmacotherapy* wish to thank Dr. Stephen Borowitz for his assistance in reviewing this article.

---

## Pharmacology Literature Review

### Cetirizine in Infants

Cetirizine, a second generation antihistamine, has recently become available in an oral syrup dosage form. Although currently approved only for children 6 years of age and older in the US, the authors of this study from Belgium have documented the use of cetirizine in younger patients. The authors studied the pharmacokinetics and pharmacodynamics of cetirizine in 15 patients under 2 years of age. These patients demonstrated a faster clearance than older age groups, but a similar duration of effect. As a result, the authors recommend a dosage of 0.25 mg/kg twice daily in this age group, pending further investigation. Spicak V, Dab I, Hulhoven R et al. Pharmacokinetics and pharmacodynamics of cetirizine in infants and toddlers. **Clin Pharmacol Ther** 1997;61:325-30.

---

### **Macrolide Review**

This brief review article describes the differences among the currently available macrolide antibiotics: erythromycin, clarithromycin, azithromycin, and dirithromycin. The authors focus on comparisons of the adverse effect profiles and the clinical efficacy studies of these agents. Pediatric health care providers may be especially interested in the section on otitis media. Charles L, Segreti J. Choosing the right macrolide antibiotic: A guide to selection. **Drugs** 1997;53:349-57.

---

### **New Antifungal Agents**

For practitioners with a desire to learn about recent innovations in antifungal therapy, this review provides a concise summation of the topic. The newer azole antifungals (itraconazole, fluconazole) are reviewed, as well as some that are still investigational. The section on liposomal amphotericin, while brief, will provide a basic understanding of this new formulation. Kauffman CA, Carver PL. Antifungal agents in the 1990s: Current status and future developments. **Drugs** 1997;53:539-49.

---

### **Formulary Update**

The following actions were taken by the Pharmacy and Therapeutics Committee at their meeting on 4/4/97:

- Atorvastatin (Liptor® ) was added to the formulary. This agent is another HMG-CoA reductase inhibitor used for the treatment of hyperlipidemia.
- Teniposide (Vumon® ), also known as VM-26, was added to the formulary for the treatment of pediatric ALL.

- Donepezil (Aricept® ) was also added to the formulary. This cholinesterase inhibitor is indicated for the management of patients with Alzheimer's disease. While it does not appear to alter the overall course of the disease, it does provide an improvement mental function for many patients.
- The following medications were removed from the formulary: isosorbide sublingual tablets, timolol tablets, disopyramide, and tocainide. Lovastatin (Mevacor® ) will be phased out over a three month period, to be replaced with other agents in its class.

---

*Contributing Editor: Marcia L. Buck,  
PharmD*

*Editorial Board: Anne E. Hendrick,  
PharmD*

*Bernadette S. Belgado, PharmD*

*Production Manager: Stephen M.  
Borowitz*

*If you have any comments or would  
like to be on our mailing list, please  
contact Marcia Buck by mail at Box  
274-11, University of Virginia  
Medical Center, Charlottesville, VA  
22908 or by phone (804) 982-0921,  
fax (804) 982-1682, or e-mail to  
mlb3u@virginia.edu.*

[Return to the Children's Medical Center Home Page](#)

Send comments to [Witz@Virginia.edu](mailto:Witz@Virginia.edu)

All contents copyright (C) 1997, Stephen M. Borowitz. All rights reserved

Revised: May 16, 1997