

Studies of Paleolithic nutrition and modern hunter-gatherer populations suggest that humans evolved on a diet different from today's typical North American diet. The diet of hunter-gatherers was lower in total and saturated fat and contained small but roughly equal amounts of omega-6 (n-6) and omega-3 (n-3) long-chain fatty acids (LCFAs), giving an n-6/n-3 ratio of about 1:1.<sup>1, 2</sup> Paleolithic humans ate diets containing appreciable amounts of omega-3 fatty acids provided by plants and the fat of wild game.<sup>2</sup>

Technological developments over the last 100 years have contributed to a shift in fat consumption patterns. Specifically, the intakes of *trans* fatty acids, found mainly in products made with hydrogenated vegetable oils, and omega-6 fatty acids, found in vegetable oils and animal products derived from grain-fed livestock, have increased over the past century.<sup>3</sup> Compared with the Paleolithic diet, the modern North American diet is high in total and saturated fat, omega-6 fatty acids and *trans* fatty acids, and low in omega-3 fatty acids.

This imbalance has led some nutrition experts to recommend increasing omega-3 fatty acid intake. Omega-3 fatty acids are now known to be essential for infant growth and development and to protect against heart disease, thrombosis, hypertension and inflammatory and autoimmune disorders.<sup>3</sup>

## What Are the Recommended Dietary Intakes of Essential Fatty Acids for Adults?

Biochemical and clinical symptoms of essential fatty acid (EFA) deficiency in adults can be prevented with a linoleic acid intake of 1-2% of total energy. Omega-3 fatty acid intake should be 10-25% that of linoleic acid or about 0.2-0.5% of total energy.<sup>4</sup>

Health Canada has established a Recommended Nutrient Intake (RNI) for the EFAs, specifying a minimum daily intake of 3% of total energy for omega-6 fatty acids as linoleic acid and 0.5% of total energy for omega-3 fatty acids as alpha-linolenic acid.<sup>5, 6</sup> At the present time, there is no Recommended Dietary Allowance (RDA) for EFAs in the United States.<sup>4</sup> A joint Food and Agriculture Organization/World Health Organization (FAO/WHO) committee recommends a desirable intake of linoleic acid between 4 and 10% of energy.<sup>7</sup> The British Nutrition Task Force recommends a minimum of 0.5% of energy from alpha-linolenic acid.<sup>8</sup>

## Is There an Additional Requirement for Omega-3 Fatty Acids during Pregnancy and Lactation?

Health Canada recommends that pregnant women consume an additional 0.05 g of omega-3 fatty acids during the first trimester and an additional 0.16 g during the second and third trimesters. Lactating women should increase their omega-3 fatty acid intake by an additional 0.25 g.<sup>5</sup>

## Is There an Optimal Dietary Ratio of Omega-6 to Omega-3 Fatty Acids?

The current dietary n-6/n-3 ratio ranges from about 10:1 to 25:1, indicating that typical North American and Western diets are low in omega-3 fatty acids compared with the Paleolithic diet on which humans evolved.<sup>3</sup> Health Canada recommends a ratio of 4:1 to 10:1, particularly for pregnant and lactating women and infants.<sup>6</sup> The FAO/WHO joint committee recommends a ratio of between 5:1 and 10:1 and advises individuals consuming diets with a higher ratio, to consume more foods containing omega-3 fatty acids such as green leafy vegetables, legumes and fish and other seafood.<sup>7</sup> The U.S. Food and Nutrition Board has not specified a dietary recommendation for the n-6/n-3 fatty acid ratio.<sup>4</sup>

## What Is the n-6/n-3 Fatty Acid Ratio of Flaxseed?

Flaxseed contains more than three times as much omega-3 as omega-6 fatty acids, giving an n-6/n-3 ratio of 0.3:1. By comparison, the ratio for corn oil is 58:1; for soybean oil, 7:1; and for canola oil, 2:1. The high level of alpha-linolenic acid in flaxseed makes it a good source of plant omega-3 fatty acids in the North American diet.

## Is There an Optimal Intake of Alpha-Linolenic Acid?

Based on measurements of omega-3 fatty acids in plasma and erythrocyte lipids, the optimal intake of alpha-linolenic acid has been estimated to be 800-1100 mg/d for children and adults. The optimal intake of the omega-3 LCFAs eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) is estimated to be 300-400 mg/d for children and adults.<sup>3</sup>



## Do Infants Require Omega-3 Fatty Acids for Growth and Development?

DHA is rapidly incorporated into the lipids of the brain and retina during the last trimester of pregnancy and the first year of life. Preterm infants fed formula rich in DHA, for example, develop visual acuity more rapidly than those fed standard infant formula low in omega-3 LCFAs.<sup>9</sup> It is now widely recognized that dietary omega-3 fatty acids, particularly DHA, are required for the optimal development of the nervous system and maturation of visual acuity in preterm and term infants.<sup>10, 11</sup>

## Is Alpha-Linolenic Acid Alone Sufficient to Meet the Needs of Infants for Omega-3 Fatty Acids?

If DHA is essential for the growth and function of the retina and brain, then how important is alpha-linolenic acid (ALA) in the diets of infants? The data are not entirely clear on this point. Using visual acuity as an indicator of infant development, two studies have shown that feeding formula containing at least 2% ALA to low-birth-weight infants<sup>12</sup> and three-month-old infants<sup>13</sup> resulted in developments in visual acuity equivalent to that seen in breast-fed infants. These studies suggest a specific role for ALA in visual development. Other studies, however, suggest that ALA alone is not sufficient to meet the EFA needs of infants and that infants have a specific dietary need for DHA.<sup>14, 15</sup> Very-low-birth-weight infants, for example, are unable to synthesize sufficient omega-3 LCFAs from ALA to maintain the usual level of incorporation of omega-3 LCFAs into plasma and erythrocyte phospholipids.<sup>16</sup> Thus, preterm infants appear to require dietary DHA because they are unable to synthesize sufficient DHA from soybean oil-based formula.<sup>9</sup>

## Should Infant Formula Be Supplemented with ALA, DHA and/or EPA?

The optimal fatty acid composition of infant formula has not been determined. Prior to the 1990s, most infant formulas contained low levels of ALA. Today, virtually all infant formulas are supplemented with ALA; in some European countries, infant formulas are

supplemented with ALA and DHA or ALA, DHA and arachidonic acid.<sup>9</sup> The main source of ALA for infant formulas in North America is soybean oil.

Experts agree that infant formulas should be designed to approximate the fatty acid composition of breast milk and include omega-3 fatty acids.<sup>3</sup> Infants may have a unique need for EFAs, particularly ALA, which is the most prevalent omega-3 fatty acid in human milk.<sup>17</sup> The n-6/n-3 ratio of infant formula may be especially important, as the relative amounts of these fatty acids influence the amounts of DHA and arachidonic acid formed in tissues.<sup>18</sup>

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