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Dietary intake of n-3 and n-6 fatty acids

A study of the fatty acid composition of breast milk from Australian women revealed that between 1981 and 1994 DHA level declined from 0.32% to 0.21% and during the same period, linoleic acid level increased from 11% to 14% (Makrides, Simmer, Neumann et al 1995). The authors speculated that these changes in fatty acid profile reflected a change in diet towards increased consumption of vegetable oils rich in linoleic acid. Similarly, in the UK there is evidence that the proportion of linoleic acid in breast milk lipids has increased from 7-10% to about 14% and while the proportion of ALA may also have increased due to increased use of rapeseed oil, Sanders (2000) reports that the proportion of DHA has declined over the last 30 years. A further cause of change was the marked decline in consumption of oily fish, which has been taking place over the last century, although a slight reversal of this trend has been reported in recent years (Taylor, Gibney and Morgan 1979, BNF 1999, Sanders 2000). As discussed by Simopoulos (1991), intake of linoleic acid in corn oil and sunflower oil increased in western countries from around the beginning of the twentieth century with the development of the modern vegetable oil industry.

Also, while meat is a potential source of n-3 fatty acids, the n-3 content of farmed animal products is low compared to products from related wild animals because modern intensive agriculture tends to rely on feeds such as grain, which are high in n-6 but low in n-3 fatty acids. Examples of this have been demonstrated in studies of meat (Crawford 1968, Crawford, Woodford and Casperd 1970, Cordain, Martin, Florant et al 1998) eggs (Simopoulos and Salem 1989) and even farmed fish (Van Vliet and Katan 1990).

Some researchers suggest that the change in dietary n-6 to n-3 ratio has happened over a longer timescale and estimate from anthropological and palaeontological studies that about 10,000 years ago, before the advent of agriculture, the Palaeolithic hunter-gatherer had a diet providing a ratio of n-6 to n-3 of approximately 1:1 (Simopoulos 1999, Eaton, Eaton, Sinclair et al 1998). It is suggested that a return to this ratio is desirable because it is part of the dietary pattern to which the human species is adapted.

Estimates of the n-6 to n-3 ratio in the modern diet are more numerous and show consistently that, in western countries, n-6 intake substantially exceeds n-3 intake (Table 2).

Table 2. Estimates of dietary n-6:n-3 intake.

Country	n-6: n-3 ratio	Reference
UK	5.7:1	MAFF (1997) quoted in BNF (1999)
UK	6.9:1	Gregory, Foster, Tyler et al (1990) quoted in BNF (1999)
USA	9.8:1	Kris-Etherton, Taylor, Yu-Poth et al (2000)
USA	16.7:1	Simopoulos (2001)
Japan	4:1	Sugano and Hirohara (2000)
Japan	4-4.5:1	Okita, Yoshida, Yamamot et al (1995)

Although published estimates indicate that the n-6:n-3 ratio in Japan is substantially lower than in the UK and USA, the Japanese figure in 1985 (3.9:1) was higher than it was in 1960 (2.9:1) because of a trend towards lower fish consumption (Lands, Hamazaki, Yamazaki et al 1990). A study of the American diet based on annual food use data, found that in 1985, 96% of total n-3 was the short chain ALA rather than the long chain fatty acids EPA and DHA (Raper, Cronin and Exler 1992). In the same study, average per capita DHA intake was estimated at 78 mg per day. A later paper stated that average intake of EPA plus DHA in American adults and children was 100 mg per day (Jonnalagadda, Egan, Heimback et al 1995). An Australian study conducted between 1989 and 1991 found that dietary intakes of long chain n-3 fatty acids, including EPA and DHA combined were less than 100 mg per day (Sinclair, O'Dea and Johnson 1994). In a recent American study of 14-15 year olds, their reported intake of long chain n-3 fatty acids (DHA, EPA and docosapentaenoic acid) was estimated at about 40 mg per day (Harel, Riggs, Vaz et al 2000).