Position Statement for Healthcare Professionals

Eggs and Omega-3s

Updated May 2012

The health benefits of foods rich in polyunsaturated fats (PUFAs) and in particular omega-3 fats have been well established. An increased intake of omega-3 fats is known to protect against heart disease[1], some inflammatory diseases and autoimmune disorders including rheumatoid arthritis[2] as well as promoting eye health[3]. Omega-3 fats also play a major role in infant growth and development, as well as behaviour, attention and learning in children [4]. The absolute amounts and sources of PUFAs in the diet are important to human health.

Recommended Dietary Intakes of Omega-3s

Health authorities such as the National Heart Foundation of Australia and the National Health and Medical Research Council recommend increased consumption of omega-3 fats, namely alpha-linolenic (ALA) and its long chain metabolites eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). ALA is a plant-based fatty acid, found in foods such as walnuts, canola oil and soybeans, whereas EPA and DHA are mainly present in marine sources (fish, shellfish, marine algae), eggs and meat. ALA is metabolised in the body to DHA and EPA however its conversion rate is low [5,6]. This limits the extent to which ALA confers health benefits, therefore the very long chain omega-3 fats DHA and EPA are thought to be the primary mediators of omega-3 health benefits.

The Heart Foundation's 2008 Position Statement on 'Fish, fish oils, n-3 polyunsaturated fatty acids and cardiovascular health' [7] recommends that to lower the risk of coronary heart disease (CHD), all adult Australians should:

1. Consume about 500mg of combined docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) per day through consumption of two or three serves (150 gram serve) of oily fish per week and other foods and drinks enriched with marine n-3 PUFA and/or fish oil capsules or liquid.
2. Consume at least 2 grams per day of alpha-linolenic acid (ALA).

People with heart disease are advised to consume even more DHA and EPA (1000mg) daily.

The NHMRC recommendations for omega-3s are based on Adequate Intake (AI) recommendations and Suggested Dietary Targets (SDTs). These recommendations are outlined in Table 1 below.

Current Intakes

Research indicates that many Australians are meeting the Adequate Intake (AI) recommendations for daily intake of omega-3 fatty acids however are failing to meet the optimal intake for disease prevention [8]. Data from the Blue Mountains Eye Study shows a mean long chain omega-3 intake of 260mg in Australians aged 55 years and over which is higher than the population mean intake, however still lower than the optimal intake for disease prevention [9]. An analysis of food intake data from the 1995 National Nutrition Survey indicated that seafood was the main source of long chain omega-3 PUFA in the Australian diet, contributing 71%, while meat and eggs contributed 20% and 6%, respectively [10]. These data indicate that there is a need for Australians to increase their daily intake of omega-3-containing foods to meet current recommendations for optimal health.

The recommended Adequate Intake values for omega-3s as set out by the National Health and Medical Research Council, compared with Australians' estimated intakes, are highlighted in table 1:

Table 1: Recommended adequate intake values for omega-3s vs. estimated intake

	Short Chain omega-3s (ALA)		Long Chain omega-3s (DHA/EPA/DPA)		Total omega-3s	
	Adequate intake [11]	**Estimated intake [10]**	**Adequate intake [11]**	**Estimated intake [10]**	**Adequate intake [11]**	**Estimated intake [10]**
Men	1.3g	1.38g (19+ yrs)	160mg (610mg for disease prevention)*	222mg (19+ yrs)	1.46g	1.60g (19+ yrs)
		1.12g (65+ yrs)		214mg (65+ yrs)		1.33g (65+ yrs)
Women	0.8g	0.99g (19+ yrs)	90mg (430mg for disease prevention)*	159mg (19+ yrs)	0.89g	1.15g (19+ yrs)
		0.86g (65+ yrs)		170mg (65+ yrs)		1.03g (65+ yrs)
Pregnant women	1.0g	-	115mg	-	1.115g	-
Lactation	1.2g	-	145mg	-	1.345g	-

* Suggested Dietary Target (SDT) value

Optimal Dietary Ratio of Omega-6 to Omega-3 Fats

The typical Western diet (characterised by a high intake of processed foods high in saturated fat, sugar and sodium) is considered by some to be imbalanced because it provides high levels of omega-6 and low levels of omega-3 fats [12,13]. Omega-6 and omega-3 compete in the body such that high levels of omega-6 block the ability of omega-3 to be used efficiently. Internationally, the FAO/WHO joint committee recommends an omega-6/omega-3 ratio between 5:1 and 10:1 [14]. However the use of the omega-6/omega-3 ratio is controversial, and there is no overall scientific consensus regarding its effect on human health. Australian data shows that for those who consume meat frequently, the ratios of omega-6/omega-3 are 9.2-9.7:1 [15], whereas ovo-lacto vegetarians or vegans have higher ratios [16] at 12.9:1 and 18.7:1 respectively [15].

The Omega-3 Index is used to measure a person's omega status and hence risk towards coronary heart disease mortality [17]. The Index is based on an omega-3 biomarker measured in cell membranes (erythrocyte eicosapentaenoic acid plus docosahexaenoic acid) and having higher levels of this biomarker in the body is thought to reduce the risk for cardiac events. Founders of the Omega-3 Index also suggest that lowering omega-6 increases the risk of heart disease, hence the omega-6/omega-3 ratio shouldn't be used as a reliable predictor of risk. There is therefore some controversy about the application of the omega-6/omega-3 ratio.

Omega-3 Fats in Eggs and Health Benefits

Eggs provide omega-3 fatty acids, contributing an average of 180mg per serve, 12% of the omega-3 AI recommendation for men and 20% for women [11]. Of this, 114mg is long chain omega-3 fatty acids, representing 71-127% of the long chain omega-3 AI. Eggs are therefore a particularly useful source of long chain omega-3 fatty acids for ovo-vegetarians and others who do not eat fish regularly. For children, one serve of eggs contributes 14-33% of their daily omega-3 AI, depending on their age. Additionally,

eggs enriched with omega-3 provide more of these fatty acids, up to 905mg ALA and 208mg long chain EPA/DHA per serve. The incorporation of such modified eggs in the Australian diet may provide an appropriate vehicle for significantly increasing omega-3 fat consumption. Table 2 highlights the fatty acid composition of Australian eggs.

Table 2: Fatty acid composition of Australian eggs

Fatty acid	Fatty acid profile (% total)	Fatty acid content (g/100g)
Oleic acid	44	4.37
Linoleic acid	11.4	1.1
Alpha linolenic acid	0.6	0.06
Arachidonic acid	1.8	0.18
DHA	1.0	0.1
DPA	0.1	0.01
EPA	0	0
Total monounsaturated	50.9	5.1
Total polyunsaturated	15.6	1.6
Total saturated	33.3	3.3
Total omega-3	1.7	0.17
Total omega-6	13.8	1.37

Studies have shown that omega-3 enriched eggs may also confer health benefits, particularly for blood lipid profiles and for infants:

Blood Lipid Profiles

- A 2007 study showed that among 25 healthy participants, consumption of five omega-3 enriched eggs a day for three weeks was associated with a significant 16-18% decrease in serum triglycerides compared to regular eggs [18]. This finding supports previous research in this area. For example, a study conducted with healthy males who supplemented their diet with two omega-3 enriched eggs per day for 18 days showed a significant increase in HDL cholesterol levels and a significant decrease in LDL cholesterol levels compared to control subjects consuming two standard eggs per day [19]. In another study of mildly hypertriglyceridaemic men consuming 10 DHA-enriched eggs per week, serum triglycerides and HDL cholesterol levels were significantly reduced [20]. Two unpublished studies also found a positive effect of omega-3 enriched eggs on cholesterol levels. One study, done with post-menopausal women, found that the intake of 1.13 omega-3 enriched eggs significantly reduced plasma triglycerides by 9.6% [21]. The second study of hypercholesterolaemic individuals and found that the consumption of four enriched eggs per week resulted in an 18% reduction in triglycerides and a slight decrease in total cholesterol [22].

Infants

- Including omega-3 enriched eggs in the weaning diets of infants may offer benefits. DHA is important for proper neurological development [23] and may also play an important role in cognitive function in infants [24]. One well-controlled trial undertaken in South Australia [25] showed the inclusion of four omega-3 enriched egg yolks a week in the diets of infants aged 6-12 months resulted in red blood cell concentrations of DHA that were 30-40% higher compared with infants fed no eggs or standard egg yolks. A major finding was that infants fed formula without DHA but who consumed four omega-3 egg yolks had red blood cell DHA percentages that were not significantly different to breastfed

infants. It was concluded that eggs enriched with omega-3 provide a means of increasing DHA in the diet during the second six months of life without altering plasma cholesterol. This in turn may improve development of visual acuity and neurological developmental outcomes. This research has also been supported with the results of an American study that fed one group of infants baby food enriched with egg yolk and DHA between 6-12 months of age and compared this to a group of control infants receiving baby food alone [26]. At the end of the six month intervention, visual acuity was significantly better in the infants receiving egg yolk and DHA.

- Another recent study[27] investigated the relationship between maternal DHA levels at birth and attentiveness of toddlers into their second year. Toddler attentiveness was assessed at 12 and 18 months. Toddlers of mothers who received high DHA eggs (135mg DHA) during pregnancy were more attentive than toddlers of mothers given low (35mg) DHA eggs. These findings are consistent with evidence suggesting a link between DHA and cognitive development in infancy and early childhood[24].

Conclusions

Many Australians fall short of the omega-3 recommendations for chronic disease prevention. Although fish is recommended as the key dietary strategy for people to increase their omega-3 intake, modern Western societies generally consume inadequate amounts of fish and therefore this dietary approach may not be an effective way to achieve an increase in the consumption of omega-3 fats. Standard eggs provide 12-20% of the omega-3 AI for adults and 14-33% AI for children, making them a useful source of this essential fatty acid in the diets of Australians. Their content of long chain omega-3s (71-127% AI for adults) provides further benefits for ovo-vegetarians and those who do not eat fish regularly. Omega-3 enriched eggs, which contain up to five times more omega-3s than standard eggs, may provide an even greater mechanism for increasing omega-3 fat consumption in Australia.

This statement is for healthcare professionals only.

**One serve = 2x60g eggs (104g edible portion)*

Useful links:

Food Standards Australia New Zealand Fact Sheets
http://www.foodstandards.gov.au/foodmatters/pregnancyandfood.cfm

References:

1. de Goede, J., Geleijnse, J.M., Boer, J.M.A., Kromhout, D. & Verschuren, W.M.M. Marine (n-3) Fatty Acids, Fish Consumption, and the 10-Year Risk of Fatal and Nonfatal Coronary Heart Disease in a Large Population of Dutch Adults with Low Fish Intake. *J Nutr* **140**, 1023-1028 (2010).
2. Wall, R., Ross, R.P., Fitzgerald, G.F. & Stanton, C. Fatty acids from fish: the anti-inflammatory potential of long-chain omega-3 fatty acids. *Nutr Rev* **68**, 280-289 (2010).
3. Schweigert, F.J. & Reimann, J. [Micronutrients and their relevance for the eye--function of lutein, zeaxanthin and omega-3 fatty acids]. *Klin Monbl Augenheilkd* **228**, 537-543 (2011).
4. Omega-3 Centre. Omega-3 fatty acids – essential nutrients for our children. *Scientific Consensus Workshop* (2007).
5. Mantzioris, E., James, M.J., Gibson, R.A. & Cleland, L.G. Dietary substitution with an alpha-linolenic acid-rich vegetable oil increases eicosapentaenoic acid concentrations in tissues. *Am J Clin Nutr* **59**, 1304-1309 (1994).
6. Brown, A.J., Roberts, D.C., Pritchard, J.E. & Truswell, A.S. A mixed Australian fish diet and fish-oil supplementation: impact on the plasma lipid profile of healthy men. *Am J Clin Nutr* **52**, 825-833 (1990).
7. Colquhoun, D., Ferreira-Jardim, A., Udell, T., Eden, B. & the Nutrition and Metabolism Committee of the Heart Foundation. Review of evidence: Fish, fish oils, n-3 polyunsaturated fatty acids and cardiovascular health. (National Heart Foundation, 2008).
8. Howe, P.R., Meyer, B.J., Record, S. & Baghurst, K. Contribution of red meat to very long chain omega-3 fatty acid (VLCOmega3) intake. *Asia Pac J Clin Nutr* **12**, S27 (2003).
9. Flood, V.M., Webb, K.L., Rochtchina, E., Kelly, B. & Mitchell, P. Fatty acid intakes and food sources in a population of older Australians. *Asia Pac J Clin Nutr* **16**, 322-330 (2007).
10. Meyer, B.J.*, et al.* Dietary intakes and food sources of omega-6 and omega-3 polyunsaturated fatty acids. *Lipids* **38**, 391-398 (2003).
11. National Health and Medical Research Council. *Nutrient Reference Values for Australia and New Zealand including Recommended Dietary Intakes*, (NHRMC, Canberra, 2006).
12. Kris-Etherton, P.M.*, et al.* Polyunsaturated fatty acids in the food chain in the United States. *Am J Clin Nutr* **71**, 179S-188S (2000).
13. Simopoulos, A.P. Evolutionary aspects of diet, the omega-6/omega-3 ratio and genetic variation: nutritional implications for chronic diseases. *Biomed Pharmacother* **60**, 502-507 (2006).
14. FAO/WHO. Fats and oils in human nutrition. Report of a joint expert consultation. (Food & Agriculture Organization of the United Nations and the World Health Organization., Rome, 1993).
15. Mann, N. Omega-3 fatty acid composition of habitual diets in Australia. *Food Aust* **57**, 130 (2005).
16. Davis, B.C. & Kris-Etherton, P.M. Achieving optimal essential fatty acid status in vegetarians: current knowledge and practical implications. *Am J Clin Nutr* **78**, 640S-646S (2003).
17. Harris, W.S. The omega-3 index as a risk factor for coronary heart disease. *Am J Clin Nutr* **87**, 1997S-2002 (2008).
18. Bovet, P., Faeh, D., Madeleine, G., Viswanathan, B. & Paccaud, F. Decrease in blood triglycerides associated with the consumption of eggs of hens fed with food supplemented with fish oil. *Nutr Metab Cardiovasc Dis* **17**, 280-287 (2007).
19. Jiang, Z. & Sim, J.S. Consumption of n-3 polyunsaturated fatty acid-enriched eggs and changes in plasma lipids of human subjects. *Nutrition* **9**, 513-518 (1993).
20. Maki, K.C.*, et al.* Lipid responses in mildly hypertriglyceridemic men and women to consumption of docosahexaenoic acid-enriched eggs. *Int J Vitam Nutr Res* **73**, 357-368 (2003).

21. Prado-Martinez, C., Moreno, M.C., Anderson, A.H.N., Martinez, R.M. & Melero, C.D. Effect of substituting standard eggs with Columbus eggs in the diet of Spanish post-menopausal female volunteers. *un-published*, 1-12 (2003).
22. Watrin, I., Brasseur, D. & Carpenter, Y.A. Effect of the consumption of omega-3 fatty acid-enriched eggs on the lipid profiles of adolescents with hypercholesterolemia. *un-published*, 1-8 (2003).
23. Williams, C.M. & Burdge, G. Long-chain n-3 PUFA: plant v. marine sources. *Proc Nutr Soc* **65**, 42-50 (2006).
24. Birch, E.E.*, et al.* Visual acuity and cognitive outcomes at 4 years of age in a double-blind, randomized trial of long-chain polyunsaturated fatty acid-supplemented infant formula. *Early Hum Dev* (2007).
25. Makrides, M., Hawkes, J.S., Neumann, M.A. & Gibson, R.A. Nutritional effect of including egg yolk in the weaning diet of breast-fed and formula-fed infants: a randomized controlled trial. *Am J Clin Nutr* **75**, 1084-1092 (2002).
26. Hoffman, D.R.*, et al.* Maturation of visual acuity is accelerated in breast-fed term infants fed baby food containing DHA-enriched egg yolk. *J Nutr* **134**, 2307-2313 (2004).
27. Kannass, K.N., Colombo, J. & Carlson, S.E. Maternal DHA levels and toddler free-play attention. *Dev Neuropsychol* **34**, 159-174 (2009).